3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes the physical, biological, and human aspects of the environment that could be affected by the proposed action and alternatives presented in Chapter 2. This chapter also identifies the effects that the proposed action and alternatives could have on these resources.

Each resource is described in terms of its current condition and the desired condition outlined for it in the Forest Plan. The effects of project alternatives on each resource are then evaluated in terms of how they respond to Forest Plan direction and desired conditions.

A section containing *Specifically Required Disclosures* is also included at the end of this chapter. This section addresses resources whose consideration is required by law or regulation, such as wetlands and floodplains.

3.1 INTRODUCTION

Chapter 3 is organized by resource areas that are key components of the affected environment or that must be analyzed in accordance with law, regulation, or policy. Resources include those associated with the issues identified in Chapter 1. Resources are grouped by physical, biological, or human elements of the environment. Each resource section is further organized into the subsections described below.

Resource

Section heading for the resource, for example: *Air* or *Wildlife*.

Resource Description

The resource is described in terms of concerns, potential issues or impacts, and objectives related to that resource.

Indicators

The indicators for each resource are identified. Indicators are the quantitative or qualitative units of measure used to estimate effects and compare the alternatives.

Forest Plan Direction

The revision of the Land and Resource Management Plan (Forest Plan) for the WRNF, completed in 2002, provides strategic, forest-wide direction for the next 10 to 15 years. The Forest Plan provides a framework that guides all day-to-day resource management operations on the WRNF, but does not make project-level decisions. This section describes Forest Plan direction for the resource addressed in the section, including national strategic goals, regional goals, forest-wide goals, objectives and strategies, forest-wide standards and guidelines, and Management Area (MA) standards and guidelines.

Desired Condition

MA descriptions in the Forest Plan are summarized and related to the resource addressed in the section. The desired condition for a resource is the goal to be achieved over time. Desired conditions are identified in the Forest Plan for each MA. By implementing the Forest Plan through management activities, conditions for resources will move from current conditions toward desired conditions.

Temporal Scope

The temporal scope is the time period in which a resource may be impacted by proposed management activities. The temporal scope varies among resources depending upon the type of effects that may occur. For example, increased erosion and sedimentation caused by surface-disturbing activities would continue until disturbed areas are successfully revegetated. Recovery of soil and water resources following disturbance would likely occur over an estimated five-year period.

Geographical Scope

The geographical scope is the area in which a specific resource may be impacted by proposed management activities. Affected areas vary in size by resource and the type of effect that may occur. For example, the affected area for direct effects on soils would be the treatment units and temporary road locations where the soils would be directly disturbed. However, the affected area for direct effects on water quality would be the drainages that would receive water affected by increased erosion and sedimentation.

Affected Environment

This section provides a brief overview of the current condition of the resources that may be affected by the proposed actions within the project area. In most cases, a more detailed description may be found in the *Project File* at the Holy Cross Ranger District Office in Minturn, Colorado. The *Project File* contains resource specialists' reports, updated information on resource conditions, and supporting data and analysis of existing conditions developed during the preparation of this EIS, which are hereby incorporated by reference.

Environmental Effects

The environmental effects are the impacts that would be expected to occur as the result of implementing each of the alternatives. This section provides the scientific and analytical basis for the comparison of the alternatives described in Chapter 2. In most cases, a more detailed analysis may be found in the *Project File* located at the Holy Cross Ranger District Office in Minturn, Colorado. The *Project File* contains supporting data and analysis of environmental effects developed during the preparation of this EIS, which are hereby incorporated by reference.

Direct and Indirect Effects by Alternative

Direct effects are caused by an action, and occur at the same time and place. Indirect effects are caused by an action, but occur later in time or farther removed in distance, but are still reasonably foreseeable.

For each resource, effects are presented in three parts. First, effects common to all alternatives are identified. Second, effects common to action alternatives are presented. Third, the effects of each alternative are discussed.

Cumulative Effects by Alternative

This section describes the cumulative effects of the alternatives. Cumulative effects result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes the other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Forest Plan Consistency

This section indicates whether the alternatives would be consistent with the Forest Plan, and how any inconsistency would be remedied by a Forest Plan amendment if that alternative were implemented.

Irreversible and Irretrievable Commitments

Federal law and regulations require the disclosure of any irreversible or irretrievable commitments of resources that may result from the proposed alternatives. Irreversible commitments are permanent or essentially permanent resource uses or losses; they cannot be reversed, except in the extreme long term. Examples include minerals that have been extracted or soil productivity that has been lost. Irretrievable commitments are losses of production or use for a period of time. For example, some of the timber production from an area is lost irretrievably while an area is serving as a winter sports site. The production loss is irretrievable, but the action is not irreversible. If the use changes, it would be possible to resume timber production.

3.2 THE PHYSICAL ENVIRONMENT

Air, water, and soil combine to create the physical environment, which is the foundation of all ecosystems. The physical environment is addressed in three sections: air; streams and watershed; and geology and soils.

3.2.1 Air

Resource Description

Fine particulate matter is an air quality concern due to its potential to adversely impact human respiratory systems. It can also reduce visibility, an air quality attribute in scenic areas. National standards for air quality have been promulgated to protect human health from pollutants such as fine particulate matter. Today, as forest managers attempt to restore a healthy ecosystem through means such as prescribed fire, they must also balance the sensitivity to smoke of a growing urban interface.

Indicators

- Annual and total project-related emissions in tons of fine particles (PM_{10} and $PM_{2.5}$) and carbon monoxide

Forest Plan Direction

The goal for air quality on the Forest is to manage Forest lands so that air quality complies with federal and state laws (Forest Plan, page 2-3).

Desired Condition

The desired condition for air quality is to minimize the generation and impacts of smoke on sensitive areas, such as population centers and scenic vistas, as well as assure that no Colorado Ambient Air Quality Standards are exceeded. No MA-specific guidance affects the desired condition for air resources.

Geographical Scope

Areas that may be directly, indirectly, and cumulatively affected by the project include the project area and downwind sites.

Affected Environment

The primary air quality issue associated with the project is smoke from prescribed fires. If not managed, smoke has the potential to temporarily impact sensitive areas such as downwind population centers and Class I areas. The Clean Air Act (as amended) provides a legal mandate to protect public health and welfare from pollution. In accordance with this mandate, the Forest Service would conduct controlled burning during climate conditions conducive to smoke dispersal, but would avoid windy conditions that make fires difficult to control. Road dust was not identified as a key issue, as analysis showed that it was not a significant source of increased particulate matter at sensitive sites. Road dust was considered in this analysis through potential mitigation measurers for dust abatement in Chapter 2.

Meteorology

The data in **Table 3-1** through **Table 3-5** represent historical climate data collected at the Eagle County Airport, Dowds Junction, and Vail. The airport is approximately 15 miles west, Dowds Junction is near the center, and Vail is on the east side of the project area.

Locally, topographic features and the heating and cooling of the earth's surface modify winds. Typically, air flows up-valley during the day and down-valley at night.

Table 3–1 and **Table 3–2** present wind data for Eagle County Airport and Dowds Junction. The Eagle County Airport data were generated by the Western Regional Climate Center (WRCC 2004) and are based on at least 2 years of hourly data. The Dowds Junction data were generated from hourly Remote Automated Weather Stations (RAWS) data for the years 2000 and 2003 (WRCC 2004).

Table 3–1 shows that, for the Eagle area, the prevailing winds are predominantly from the east and shift to the west from spring to early summer. The Dowds Junction data (**Table 3-2**) would be more representative of the project area and are presented as daytime (6:00 AM to 6:00 PM) and nighttime (6:00 PM to 6:00 AM) values. During the daytime at this site, winds from the west are predominant through the year. These data also show a distinct diurnal pattern for the prevailing winds.

Table 3–1 Historical Wind Data - Eagle County Airport

	Month												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Prevailing Wind Direction	E	E	E	W	W	WSW	E	E	E	E	E	E	E
Average Wind Speed (mph[1])	4.1	4.7	5.7	7.1	6.9	7.0	5.6	5.1	5.3	5.0	3.9	3.6	5.3

[1] mph = miles per hour

Table 3–2 Historical Wind Data – Dowds Junction

	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Prevailing Daytime Wind Direction	W	W	W	W	W	W	W	W	W	W	W	W
Average Daytime Wind Speed (mph)	6.5	7.3	9.6	9.3	9.8	9.0	6.9	6.8	7.3	7.9	5.1	5.3
Prevailing Nighttime Wind Direction	ENE	ENE	W	ENE	ENE	ENE	E	E	ENE	E	E	E
Average Nighttime Wind Speed (mph)	3.5	3.6	4.7	5.7	5.5	5.0	5.8	5.1	4.3	3.7	3.7	4.0

Table 3–3 shows that a wide range of temperatures can be expected in the project area. Temperature inversions, generally caused by radiative cooling, are common. Summer inversions usually break up by mid-morning. Winter inversions are typically stronger and persistent, and can last for more than a day under severe conditions. Nocturnal inversions can trap pollutants until daybreak when stagnant air is replaced by trans-valley winds.

Table 3–3 Historical Temperature Data (°F)

Season	Monthly Average		Daily Maximum		Daily Minimum	
	Vail	Eagle	Vail	Eagle	Vail	Eagle
Annual	38	42.7	95	100	-32	-51
Winter	18.8	21.1	55	65	-32	-51
Spring	37.6	42.4	82	90	-16	-20
Summer	57.1	63.3	95	100	19	23
Fall	38.6	44	86	93	-13	-29

Table 3–4 shows that precipitation rates are fairly consistent throughout the year, and **Table 3–5** demonstrates that snowfall contributes significantly to the annual precipitation.

Table 3–4 Historical Precipitation Data (inches)

Season	Annual or Monthly Average		Annual or Monthly Maximum		Annual or Monthly Minimum		Daily Maximum	
	Vail	Eagle	Vail	Eagle	Vail	Eagle	Vail	Eagle
Annual	21.99	10.65	29.60	16.16	15.84	6.47	2.67	1.31
Winter[1]	5.23	2.32	10.40	5.93	2.40	0.39	1.45	1.31
Spring[1]	5.90	2.46	10.74	5.47	3.10	0.93	2.67	0.96
Summer[1]	5.34	3.10	9.10	8.68	2.01	0.99	1.50	1.26
Fall[2]	5.51	2.76	9.87	6.79	3.01	1.09	1.20	1.10

[1] Monthly

Table 3–5 Historical Snowfall Data (inches)

Season	Mean		High	
	Vail	Eagle	Vail	Eagle
Annual	187.6	47.7	331.7	93.0
Winter	95.6	27.0	181.1	73.9
Spring	51.7	11.7	99.4	36.1
Summer	0.4	0.1	4.5	2.9
Fall	39.9	8.9	64.9	28.9

Sensitive Sites

Sensitive sites are those areas potentially downwind of the project area that are sensitive to smoke or dust impacts, such as reduced visibility and increased concentrations of particulates.

For the project, sensitive areas include population centers (Avon, Vail, and Minturn); recreational areas (Vail and Beaver Creek ski areas); and a major transportation corridor (I-70). Those areas that lie in the valley bottom are most vulnerable to smoke settling during nighttime from smoldering fires.

Other sensitive sites include nearby air quality areas including the Eagles Nest Wilderness (Class I), Holy Cross Wilderness (Class II), Flat Tops Wilderness (Class I), and Rocky Mountain National Park (Class I). Class I areas have been designated by Congress through the Clean Air Act amendments (1977) to protect their pristine air quality. Greater protection measures apply to safeguard these areas, and include stricter air quality standards for fine particulate matter and visibility.

Applicable Air Quality Standards

Timber fires can generate significant amounts of fine particulate matter and can impact health and visual range. At close range, these fires can also generate significant amounts of carbon monoxide (CO), which is usually more of a concern for fireline personnel than others located away from the fire. Equipment used for project implementation can also generate emissions of air pollutants.

Smoke from prescribed burning and dust from project equipment could affect air quality. Fine particulate matter, particulate matter less than 10 microns (PM_{10}), and particulate matter less than 2.5 microns ($PM_{2.5}$) from these activities is of specific concern because of its potential to adversely impact human respiratory systems.

Fine particulate matter can adversely affect respiratory systems, acting first on the most sensitive individuals such as young children, the elderly, or those with lung disease or asthma. National Ambient Air Quality Standards (NAAQS) have been established to protect public health from air pollutants. These standards have been adopted by the State of Colorado. NAAQS for PM_{10}, $PM_{2.5}$, and CO are and are listed in **Table 3–6**.

Table 3–6 Federal National Ambient Air Quality Standards

Pollutant	Ambient Standard Concentration		Averaging Time
	parts per million	micrograms per cubic meter	
Carbon Monoxide (CO)	9	10,000	8-Hour
	35	40,000	1-Hour
Particulate Matter (PM_{10})[2]	NA[1]	50	Annual
	NA	150	24-Hour
Particulate Matter ($PM_{2.5}$)[2]	NA	15	Annual
	NA	65	24-Hour

1 Not Applicable
2 Particulate matter is the term used for tiny particles of solid or semi-solid material suspended in the air. Particles that are 10 microns and smaller are considered inhalable. Coarse particles, from 2.5 to 10 microns in diameter, come from sources such as windblown dust or from the operation of the vehicles and equipment. Fine particles, less than 2.5 microns in diameter, come from combustion and vehicle exhaust.

Relevant State and Federal Requirements and Policies

The Colorado Smoke Management Memorandum of Understanding requires the Forest Service to conduct its prescribed burns under conditions permitted by CDPHE - Air Pollution Control Division. Each prescribed burn must have a burn plan that is reviewed by the Division. Burn plans are approved based on model outputs of particulate matter concentrations and visibility values at selected sensitive receptors.

The EPA's Interim Air Quality Policy on Wildland and Prescribed Fires provides guidance for mitigating air pollution impacts caused by wildland and prescribed fires, while recognizing the current role of fire in wildland management. It identifies the responsibilities of wildland managers and air quality managers to work together to coordinate fire activities, minimize air pollution emissions, and manage smoke from prescribed fire.

Current Air Quality Conditions

The project area lies within an attainment area for all criteria pollutants, including PM_{10} and $PM_{2.5}$. This means that the area is in compliance with the federal standards shown in **Table 3–6**.

The only air quality monitoring data for Eagle County were collected in the town of Vail. Ambient concentrations of PM_{10} have been monitored in Vail from 1996 to 2001 at Forest Road 846 (EPA 2004a). Over this period, monitoring has shown that EPA standards have not been exceeded and that both 24-hour maximum and annual average concentrations have decreased (EPA 2004b).

The existing condition of air-quality-related visual values can be defined by the Standard Visual Range (SRV) at nearby Class I areas. The Eagles Nest Wilderness has an average SRV of 226 kilometers, and Rocky Mountain National Park has an average SRV of 153 kilometers.

Environmental Effects

Direct and Indirect Effects by Alternative

Alternative A – No Action

Under Alternative A, the No Action alternative, there would be no new impacts to air quality, provided a wildland fire does not occur. There would be a risk of air quality impacts from a wildland fire. Smoke from wildland fires can significantly affect air quality and could potentially produce the greatest amount of air emissions in the project area. Both gases and particulate emissions occur during the combustion of forest fuels. The emission rates (the amount of emissions produced per unit of time) can vary significantly depending on a variety of factors, including fuel type and amount, condition, and combustion characteristics. Smoke from wildland fires can contain high concentrations of fine particulate matter. Concentrations of 5,000 micrograms per cubic meter for PM_{10} have been measured on some wildland fires (USFS 2003a).

Large wildland fires have been common in recent years in Colorado, including the Buffalo Creek fire in 1996, the Hi Meadow fire in 2001, and the Hayman fire in 2002. These hot, fast-moving fires ranged in size from 10,000 acres to more than 137,000 acres. West slope fires, occurring in vegetation types similar to the Vail Valley project area, include the Big Fish fire in 2003 and the Ute Creek fire in 1994. These fires resulted in visible smoke in population centers to the east.

Because of the current forest conditions in the project area and surrounding areas and the increasing mortality of lodgepole pine from mountain pine beetle (MPB) infestation, large crown fires could occur in the project area. Smoke from large wildland fires would contribute considerable emissions to the local air shed for a period that could range from a few days to several weeks. Smoke from fires such as the Hayman fire in Colorado and the Cerro Grande near Los Alamos, New Mexico was noticeable for hundreds of miles (Graham 2003).

The No Action alternative would lead to an increase in fuel buildup and potential for increased severity or extent of wildland fire, resulting in increased emissions of air pollutants from smoke if a wildland fire occurs. Wildland fire can result in more acres burned and more fuel consumed, creating more air pollutant emissions than a prescribed fire might produce. Wildland fires tend to ignite under fuel moisture and meteorological conditions that are generally avoided by fire management specialists planning prescribed fires. Because wildland fires are not timed for favorable meteorological conditions, wildland fires could have more significant air quality impacts on surrounding communities than prescribed fires. Alternative A would have no prescribed fires, but would have potential for uncontrolled wildland fires.

Alternative B

Alternative B would reduce fuel loading by thinning, patch cuts, sanitation, and salvage in lodgepole pine treatment units and prescribed burning and mechanical treatments in shrublands and aspen. Fuel loading is an air quality concern from the perspectives of both wildland fire and prescribed fire. The amount of air pollutants emitted from a fire is related to the amount of fuel burned. Fuels include accumulated forest and shrubland debris, such as dead standing and down timber, dead branches, fallen leaves and needles, and dead grasses and shrubs. Slash left over from harvest activity is also fuel. Live fuels are also a factor, especially when surrounded by dead woody material that can serve to feed a fire and intensify flame heights thereby burning more of the tree, even its crown, given the right conditions.

The effects of wildland fire under Alternative B would be similar to Alternative A, but reduced fuel loads and enhanced fuelbreaks under Alternative B may lessen the severity or extent of the burn, reducing the

effects of smoke on air quality. Indirect effects from the project would include a reduction in the intensity of wildland fires near residential areas. Wildland fires are likely to occur in the project area, but the acres burned and the intensity of the burn could be reduced under Alternative B, thus reducing effects of smoke on air quality near residential areas.

The operation of heavy equipment and vehicles under Alternative B would generate low levels of particulate matter (PM) emissions as well as tailpipe exhaust emissions. Project-related traffic would be expected to consist of one to two vehicle trips per day, on average, and up to 20 vehicle trips per day during the most intense project activities. If the amount of particulates generated by this amount of traffic in the lodgepole pine treatment units should become a localized problem, dust abatement measures would be applied, as described in Chapter 2.

Alternative B includes prescribed broadcast burns and pile burns to remove additional fuels. Although prescribed fires would generate emissions of air pollutants, these would lower the probability of greater emissions from uncontrolled wildland fires.

The broadcast burns under Alternative B are proposed for shrubland areas with varying densities of aspen stands. This type of prescribed fire may involve many lines of fire in a pattern that allows the strips of fire to burn together over a sizeable area. Only small areas burn at a time and these are designed to burn into each other. These fires would be hot enough to burn the tree cambium layer without causing a crown fire. Such fires mimic naturally occurring wildland fires by killing existing mature trees and allowing uneven aged forests to develop, enhancing forest diversity.

Pile burns under Alternative B would require gathering the cut trees into piles that, subsequently, would be burned. This type of fire would be expected to be similar to slash burning.

Slash generated by these alternatives could be utilized rather than burned on site by opening up an area for fuel-wood cutting. Scattering slash would disperse potential fuel, and therefore, reduce the ladder – fuel effect that can intensify a fire when slash is piled or concentrated in a relatively small area.

Prescribed Fire Air Pollutant Emissions

Management-ignited fires result in lower smoke emissions than wildland fires because ignitions would occur during optimal climate conditions to limit impacts, and because fire managers would limit the acreage burned. The conditions and limits for smoke emissions from wildland fires are not controlled, thus these unplanned ignitions have the potential for greater impacts.

Prescribed fires are conducted under conditions favorable to air pollutant dispersal whereas wildland fires do not necessarily occur when wind velocity, wind direction, and other dispersion factors are conducive to dispersing air pollutants and minimizing impacts at sensitive receptors. Prescribed fires can reduce potential emissions of air pollutants by reducing the availability of fuel for future wildland fires.

FOFEM Modeling

FOFEM (First Order Fire Effects Model, v. 5.00) was used to project air pollutant emissions for prescribed fires under Alternative B. A technical report describing the model execution is included in the *Project File*.

This model accounts for emissions generated during the flaming and smoldering phases of a fire. The amount of emissions produced is related to the different phases of combustion. The smoldering combustion phase is a very inefficient and incomplete combustion process. This phase emits pollutants at a much higher rate relative to the quantity of fuel than the flaming combustion phase.

Smoke from prescribed fires is a complex mixture of carbon, tars, liquids, and different gases. The major air pollutants from prescribed fires are particulate matter with a nominal aerodynamic diameter less than 10 micrometers (PM_{10}) and 2.5 micrometers ($PM_{2.5}$), and carbon monoxide (CO).

Table 3–7 presents the estimated acreages of fuel removal and prescribed fires (broadcast burns and pile burns) that would occur. Some cover types in the proposed treatment units, such as rock outcroppings, were not included in the prescribed fire acreage. This exclusion explains the variation in acreage for each alternative when compared with **Table 2-2**.

Table 3–7 Prescribed Fire Acreage for Each Alternative by Cover Type

Cover Type	Alternative B	Alternative C	Alternative D
Bitterbrush-Bluebunch Fescue	40	40	40
Mountain Big Sagebrush	169	169	169
Tall Forb	72	72	72
Aspen Woodland	1,539	1,018	802
Chokecherry-Serviceberry-Rose	64	64	64
Total[1]	1,884	1,363	1,147

[1] Totals are rounded in Table 2-2.

Table 3–8 through **Table 3–10** present the estimated total project-related emissions of PM_{10}, $PM_{2.5}$, and CO as flaming emissions, smoldering emissions, and total emissions.

Table 3–8 Estimated Total Project Emissions (Tons) - Flaming Emissions

Air Pollutant	Alternative B	Alternative C	Alternative D
PM_{10}	16.4	8.6	10.5
$PM_{2.5}$	14.2	7.4	9.1
CO	35.5	18.3	22.6

Table 3–9 Estimated Total Project Emissions (Tons) - Smoldering Emissions

Air Pollutant	Alternative B	Alternative C	Alternative D
PM_{10}	489.3	185.8	260.9
$PM_{2.5}$	415.1	157.6	221.3
CO	5,527.4	2,099.0	2,946.5

Table 3–10 Estimated Total Project Emissions (Tons) - Total Emissions

Air Pollutant	Alternative B	Alternative C	Alternative D
PM_{10}	505.7	194.4	271.3
$PM_{2.5}$	429.3	165.0	230.3
CO	5,562.9	2,117.3	2,969.0

The total emissions for all of the prescribed fires represent a mix of cover types and proposed treatments. It would not be possible to schedule specific treatment units by year in advance, to estimate the annual emissions. For the purpose of this analysis, it is assumed that the proposed fuels treatments could be accomplished within two years. **Table 3–11** through **Table 3–13** reflect projected annual emissions. The

emission values displayed would not occur at one time but over a period of time, and would vary according to the size and type of each fire. Broadcast burns that are about 100 acres or more in size would likely burn over 2 or more days, resulting in less emissions per day but increasing the risk and occurrence of night-time settling of smoke.

Table 3–11 Estimated Annual Emissions (Tons) - Flaming Emissions

Air Pollutant	Alternative B	Alternative C	Alternative D
PM_{10}	8	4	5
$PM_{2.5}$	7	4	5
CO	18	9	11

Table 3–12 Estimated Annual Emissions (Tons) - Smoldering Emissions

Air Pollutant	Alternative B	Alternative C	Alternative D
PM_{10}	245	93	130
$PM_{2.5}$	208	79	111
CO	2,764	1,050	1,473

Table 3–13 Estimated Annual Emissions (Tons) - Total Emissions

Air Pollutant	Alternative B	Alternative C	Alternative D
PM_{10}	253	97	135
$PM_{2.5}$	215	83	116
CO	2,782	1,059	1,484

Table 3–14 presents the estimated emissions of PM_{10}, $PM_{2.5}$, and CO for a representative burn as flaming emissions, smoldering emissions, and total emissions. These values are based on a complete burn of Unit 313 (**Appendix D**). This unit consists of 325 acres of aspen woodland.

Table 3–14 Estimated Emissions for a Representative Burn (Tons)

Air Pollutant	Flaming Emissions	Smoldering Emissions	Total Emissions
PM_{10}	2.6	100.8	103.4
$PM_{2.5}$	2.3	85.5	87.8
CO	5.7	1,138.2	1,143.8

Low areas, such as valley bottoms, are most at risk of seeing high nighttime concentrations of air pollutants when a fire burns more than 1 day. Unless there is an inversion, pollutants would disperse from low areas as thermal atmospheric movement and turbulence develops throughout the day. In order to avoid or mitigate adverse air quality impacts to downwind areas, large fires (more than 300 acres) would be ignited only when wind conditions favor good to excellent smoke dispersion.

Mitigation measures must be applied for smoke management to protect human health, comply with the Clean Air Act, and avoid a violation of the NAAQS for $PM_{2.5}$ and PM_{10}. These mitigations could include reducing the volume of material burned within a specified period of time and burning during meteorological conditions favorable to air pollutant dispersion. When a fire is planned near a population center, wind direction and the potential for inversions will be taken into account to avoid air quality impacts in a sensitive area.

To avoid the potential for a prescribed fire to escape control and burn as a wildland fire, which would likely burn more fuel and produce more air pollutant emissions than a prescribed fire, prescribed fires are carried out under conditions that will not create the hazards posed by uncontrolled fires. Smoke is monitored for larger fires to ensure attainment of smoke management goals. These mitigation measures become increasingly important for larger prescribed fires.

Under Alternative B, prescribed fires would be managed to avoid impacting downwind communities. This may include reducing the size of the fire and/or burning only during excellent dispersal conditions. One air quality benefit would be the potential reduction of fuels available to burn under the uncontrolled conditions of a wildland fire.

Alternative B would treat the most acres through prescribed fire and would result in greater total emissions of air pollutants.

Alternative C

The effects under Alternative C would be similar to Alternative B with the following exceptions. Alternative C would only include pile burns and would have the least prescribed fire acreage of the action alternatives. Alternative C would have the fewest emissions of the action alternatives. The pile burns associated with this alternative should have the most effective combustion and air pollutant dispersion. Smoldering piles may create impacts when conditions are not optimal for dispersion, but it is assumed that most of the fuel will be consumed prior to the smoldering phase.

The emissions estimated for Alternative C were generated using broadcast burn emission factors because pile burn emissions cannot be generated with the current version of FOFEM. A pile burn should maintain higher temperatures and create better gas mixing; therefore, this burn method should generate less products of incomplete combustion (PICs). PICs include PM_{10}, $PM_{2.5}$, and CO. In other words, the total pile burning emission profile should be more like the flaming emission profile than the smoldering emission profile. In addition, the greater heat generated by pile burns should improve the vertical dispersion of pollutants, thus lowering the potential for ground level impacts.

Alternative D

Alternative D would have the second largest acreage of prescribed fires, conducted as broadcast burns and pile burns. The effects would be similar to those described for Alternative B with fewer emissions.

Cumulative Effects by Alternative

Alternative A – No Action

Under Alternative A, the No Action alternative, no vegetation treatments, including prescribed burns, would reduce fuel loads and no fuelbreaks would be enhanced. Should a wildland fire occur under this alternative, larger volumes of accumulated fuels could be consumed by fire and result in greater emissions of air pollutants.

If the ambient air quality in the project area is affected by emissions from other fires, wildland fire within the project area could increase air pollutant concentrations in the Vail Valley area. Wildland fire in the project area could also contribute to air pollutant concentrations in other areas outside and downwind of the Vail Valley.

Alternative B

Under Alternative B, vegetation treatments, including prescribed burns, would reduce accumulated fuel loads and enhance fuelbreaks. Should a wildland fire occur under this alternative, smaller volumes of accumulated fuels would be consumed by fire, resulting in lower emissions of air pollutants.

Emissions of air pollutants from a prescribed fire would result in a transitory impact that would last as long as the fire. The concentration of smoke depends on meteorological conditions and the amount of material burned in any given time period. Smoke combined with other air pollutants, such as dust and smoke from other fires, can result in greater concentrations of air pollutants in an area.

Prescribed fires are ignited under favorable meteorological conditions. As such, particulates from dust and smoke from other fires would not be expected to result in any additional and cumulative effect. Wildland fires could occur in the project area under Alternative B. If the ambient air quality in the project area is affected by emissions from other fires, wildland fire within the project area could increase air pollutant concentrations in the Vail Valley area. Wildland fire in the project area could also contribute to air pollutant concentrations in other areas outside and downwind of the Vail Valley. Although a controlled burn may also contribute air pollutants to these areas, the amounts contributed should be less because of the potentially lower emissions from controlled burns.

Sanitation and salvage in areas where mortality from mountain pine beetle (MPB) is high, or possible re-entry after 10 years into the lodgepole pine treatment units where ladder fuels need treatment or not enough basal area was removed under Alternative B to effectively modify future MPB risk would not be expected to result in cumulative conditions that would exceed the project-only effects for the lodgepole pine treatments. The operation of heavy equipment and vehicles during adaptive management of MPB mortality or re-entry treatments would generate low levels of particulate matter (PM) emissions as well as tailpipe exhaust emissions. Traffic related to re-entry treatments would be expected to consist of one to two vehicle trip per day, on average, and up to 20 vehicle trips per day during the most intense adaptive management or re-entry activities. If the amount of particulates generated by this amount of traffic in the lodgepole pine treatment units should become a localized problem, dust abatement mitigation measures would be applied, as described in Chapter 2.

Alternative C

The cumulative effects for Alternative C would not be expected to vary from those described above for Alternative B.

Alternative D

The cumulative effects for Alternative D would not be expected to vary from those described above for Alternative B.

Forest Plan Consistency

With properly managed prescribed fires, all alternatives in this proposal are consistent with the Forest Plan.

Irreversible and Irretrievable Commitments

There would be no irreversible air quality commitments as a result of any of the action alternatives. Any air quality impacts related to the alternatives would be temporary, and should have no long-term consequences. Under Alternative A, the No Action alternative, there would be an increase in the buildup of natural fuels over time, which could feed a larger or more severe wildland fire that would produce more smoke. The effects of a larger or more severe wildland fire on air quality would become increasingly difficult to reverse.

3.2.2 Streams and Watershed

Resource Description

Stream health and riparian condition can be affected by ground disturbing activities, and by removal of vegetation. Soil erosion and increased runoff from road surfaces, skid trails, landings, and burn areas could cause increased sedimentation to streams and loss of stream bank stability. Thinning, patch cuts, sanitation, and salvage of lodgepole pine, aspen treatments, temporary roads, and log landings can also affect riparian and aquatic habitat.

Indicators

- Connected Disturbed Areas (CDA) in acres of disturbance connected to stream channel water influence zone (WIZ) by third order and larger watershed (The U.S. Geological Survey has delineated watersheds at different scales referred to as watershed orders or levels. The more detailed the delineation, the higher the order.)
- Stream Network Expansion (SNE) in percent change in stream density for all streams, caused by road drainage
- Long-term effects on stream health class

Forest Plan Direction

The overall direction for managing the WRNF includes the national strategic goals of restoring degraded watershed areas, improving soil and water quality, retaining soil stability, securing timely water flow, and preserving aquatic values (Forest Plan, pages AA-17 and AA-18). Overall management direction for the WRNF also includes the regional goal of protecting basic water resources (Forest Plan, page 1-1). Forest-wide goals include the objective to improve and protect watershed conditions to provide the water quality, water quantity, and soil productivity necessary to support ecological functions and intended beneficial uses (Objective 1a, Forest Plan, page 1-3). One strategy to meet this objective specifies that project-level NEPA analysis must be conducted at a minimum sixth-level hydrologic unit code (HUC) scale (Strategy 1a.1, Forest Plan, page 1-3).

Forest-wide standards for water and riparian resources (Forest Plan, pages 2-6 and 2-7) include the following requirements that could apply to the proposed project:

- Maintain sufficient habitat and flow for self-sustaining fisheries, and, where reproduction does not occur, maintain recreational fisheries.
- Manage land treatments to conserve site moisture and protect long-term stream health from damage by increased runoff.
- Manage land treatments to maintain enough organic ground cover in each land unit to prevent harmful increased runoff.

- Retain (do not remove) naturally occurring debris from stream channels.
- In the WIZ adjacent to perennial and intermittent streams, lakes, and wetlands, allow only those actions that maintain or improve long-term stream health and riparian ecosystem condition.
- Design and construct all stream crossings and other instream structures to provide for passage of flow and sediment, withstand expected flood flows, and allow free movement of resident aquatic life.
- Conduct actions so that stream pattern, geometry, and habitats are maintained or improved toward robust stream health.
- Maintain long-term ground cover, soil structure, water budgets, and flow patterns of wetlands to sustain their ecological function, per 404 regulation.

Forest-wide guidelines for water and riparian resources (Forest Plan, page 2-7) specify that large, woody debris be retained in natural and beneficial volumes, and vehicles or equipment be kept out of streams, lakes, and wetlands except to cross at designated points or for certain activities. There is no specific direction for watershed management for any MA in the project area.

In addition to Forest Plan guidance, *Forest Service Handbook 2509.25*, *Watershed Conservation Practices* (WCP), provides a quantified approach to evaluating watershed effects. For each standard listed in the Forest Plan, the WCP handbook provides a monitoring guide that specifies how to measure project compliance with the standard.

In addition to Forest Service guidance, the State of Colorado regulates water quality through the Colorado Department of Public Health and Environment (CDPHE) and the Water Quality Control Commission.

Desired Condition

The desired condition for streams and watershed, interpreted from Forest Plan guidance, is to provide water quality and soil productivity that supports ecological functions and beneficial uses. Specifically, areas of disturbance in the WIZ should be limited to a level that maintains or improves stream health. All management actions should maintain or improve stream health toward the robust class.

Temporal Scope

The temporal scope includes the period immediately following implementation of the proposed treatments. The first year following disturbance is anticipated to be the period of greatest alteration of the factors influencing soil erosion, runoff, and sediment transport. As time passes following implementation of the proposed treatments, the magnitude and intensity of these effects would decline because of the following factors.

- Reclamation of temporary roads, landings, and skid and tractor trails
- Removal of temporary road channel crossings
- Re-establishment of surface drainage
- Increased evapotranspiration from forest and shrub land regeneration
- Decomposition of felled trees, and redistributed slash and coarse woody debris (CWD)

Geographic Scope

The project area boundary includes the Gore Creek watershed, and a portion of the Eagle River watershed. In Gore Creek, the project boundary extends west from Vail Pass to the confluence with the Eagle River. In the Eagle River, the project boundary extends from the mouth of Cross Creek near

Minturn, to McCoy Creek below the town of Avon. Gore Creek has a drainage area of more than 100 square miles, while the Eagle River above Avon has a drainage area of more than 420 square miles.

Affected Environment

The existing stream health and riparian condition descriptions provided in this section were primarily derived from the Forest Service review of stream channel conditions in tributaries of Gore Creek and the Eagle River (Laurie 2003).

The elevation in the area varies from 13,357 feet at the headwaters of Gore Creek, to 7,320 feet at the confluence of McCoy Creek and the Eagle River. Mean annual precipitation ranges from more than 36 inches in the Gore Range, to about 16 inches near Avon (Western Regional Climate Center).

Runoff in the project area is dominated by snowmelt, with peak flows typically occurring in late May or early June. Between 1996 and 2002, the mean monthly flow in June in Gore Creek at its mouth was 614 cubic feet per second (USGS 2003). Between 1990 and 2002 the mean monthly flow in June in the Eagle River near Minturn, Colorado was 503 cubic feet per second (USGS 2003). Between 1964 and 2002, the mean monthly flow in Bighorn Creek (a tributary to Gore Creek) in June was 48 cubic feet per second (USGS 2003). High flows occur periodically in tributaries as a result of high intensity storm events in August and September. During the winter months from November to March, stream flows are low and ice cover is prevalent.

Fifteen tributary streams with drainage areas that vary in size from 0.9 to 14 square miles are located in the project area. Most streams are third order channels that drain the steep side slopes of the Vail and Eagle River Valleys. Stream morphology can generally be classified as Type A3, A3a+, or B3 channels according to the Rosgen Channel Classification (Rosgen 1996). Type A streams are single thread channels that are narrow and moderately deep. Type Aa+ streams are those with a channel slope greater than 10 percent. Type B streams are wider than Type A streams and have a broader valley. For all three types, channels have a step-pool bedform that stores large amounts of sediment in pools and behind obstructions. Lower-gradient, Type B3 reaches are typically located where streams exit the valley side-slopes. These reaches flow about one quarter mile across the valley bottom before joining Gore Creek or the Eagle River.

The Forest Service manages most of the upper and middle portions of the third order streams in the project area. The lower reaches along the valley bottom are highly urbanized residential and commercial development areas. Land uses on NF administered lands include winter sports, other developed and dispersed recreation activities, grazing, and timber harvest. Tributaries on the east side of the Gore Creek watershed (Booth, Pitkin, Bighorn, Upper Gore, and Polk Creeks) are located in the Eagles Nest Wilderness. The headwaters of tributaries on the southeast side of the Eagle River watershed (Beaver, Grouse, and Martin Creeks) are located in the Holy Cross Wilderness. I-70 and U.S. 24 are located on the valley floor and cross the mouths of most streams.

No municipal water supplies have been identified in the project area except for an auxiliary point on Gore Creek above the mouth of Black Gore Creek. The facility is operated by the Eagle River Water and Sanitation District and is not used full-time. No major lakes or reservoirs are located within the project area. All domestic wells were consolidated into the sanitation district several years ago (Morrow 2003). The state has designated the main channel of Gore Creek downstream from Red Sandstone Creek as a gold medal trout fishery. The gold medal reach has a high trout productivity that provides an important recreational fishery.

Previous studies have shown that most tributary streams in the project area have excellent water quality (Wynn et al. 2001). Clean water from tributary streams dilute and improve degraded water quality in Gore Creek. Water quality in the main channel of Gore Creek has been degraded by urban development and highway runoff. Highway sanding along I-70 in the upper reaches of Black Gore Creek has impacted habitat for trout and macroinvertebrates. Specific conductance measures the ability of water to conduct an electrical current and can be used to estimate the dissolved solids in water. High values for specific conductance in Black Gore Creek are diluted by water from Upper Gore Creek, Bighorn Creek, Pitkin Creek, and Booth Creek. Mill Creek and Black Gore Creek are the only tributaries where the USGS has identified degraded water quality. Mill Creek was identified as a source of increased dissolved solids and specific conductance for the main channel of Gore Creek. High specific conductance in Mill Creek is attributed to ski area development and sedimentary geology.

The stream segments intended for inclusion on CDPHE's preliminary list of water-quality-limited streams in the project area and the parameters for which they are listed are: Eagle River from Belden to Gore Creek – copper and manganese; Cross Creek from its source to the Eagle River (except for Segment 1) - copper and manganese; tributaries to the Eagle River from its source to Belden (except specific segments) – sediments; and Black Gore Creek, adjacent to I-70 – sediments (CDPHE 2003).

Because of the relatively large size of Gore Creek and the Eagle River, any effects in the tributaries would be masked by activities in the larger watershed or diluted by large flows. Therefore, analysis was limited to third order and larger tributaries to Gore Creek and the Eagle River where the effects of the proposed treatments would be most detectable.

Quantifiable methods identified in the WCP handbook were used by the Forest Service to establish baseline conditions in the project area watersheds. The existing stream health of project area watersheds was measured in comparison to the health of minimally impacted reference streams. The criteria used for selecting reference streams are identified in guidance from the EPA (1996), and CDPHE (2002). Reference streams generally have a connected road density of less than 0.2 kilometers per square kilometer, little or no grazing, no flow diversions or impoundments, and no urban areas or ski area development.

Stream health classes are based on measurements of the physical habitat as a percentage of the reference stream. Stream health classes provided in **Table 3–15** are adapted from EPA (1989), FSH 2509.25 (USFS 1999a); CDPHE (2002); and Ohlander (1996a, b).

The WCP handbook design criteria identify CDA as a method to measure compliance with the following standards (Forest Plan - Water and Riparian Resources, Standard No. 2 and Soils, Standard Nos. 1, 2, 3, and 4). CDAs are high runoff areas like roads, road ditches, and other disturbed sites that provide a conduit for surface runoff to route sediment to the WIZ of streams or lakes. The maximum allowable length of CDA in each third order and larger watershed is limited to a total SNE of no more than 10 percent. The length and area of roads that drain into the WIZ of streams were measured by the Forest Service (Laurie 2003) to determine baseline condition and as the basis for assessment of the effects of the proposed treatments on stream health. To calculate the amount of SNE, connected road length was reported as the percent change in the natural stream density.

Table 3–15 Stream Health Classes

Stream Health Class	Percentage of Reference Habitat	Habitat Condition
Robust / Comparable	Greater than 90	Forest Plan standards are attained. Habitat supports aquatic life uses. State standards are attained.
Supporting	74 to 89	Forest Plan standards are not attained. Habitat supports aquatic life uses. State standards are attained.
Partially Supporting	59 to 73	Forest Plan standards are not attained. Habitat for aquatic life uses is not fully supported. State standards are threatened if biological condition is less than 50 percent of reference stream.
Nonsupporting	Less than 58	Forest Plan standards are not attained. Habitat for aquatic life uses is not supported. State standards are not attained if biological condition is less than 17 percent of reference stream.

Another method used to measure compliance with the following standards (Forest Plan - Water and Riparian Resources Standard Nos. 5 and 9) is to measure activities located in or encroaching upon the WIZ. The WIZ is a riparian buffer that includes the floodplain, riparian vegetation, inner gorge, unstable areas, or highly erodible soils. The minimum width of the buffer on each side of a stream is 100 feet, or the mean height of mature dominant late-seral vegetation, whichever is greater. The length and acres of existing WIZ (assuming a width of the buffer on each side of a stream equal to 100 feet) in the project area by third order and larger watershed is provided in **Table 3–16.**

Table 3–16 Existing Water Influence Zones

Watershed	Water Influence Zone - Acres			Water Influence Zone - Miles		
	Perennial	Intermittent	Total	Perennial	Intermittent	Total
Bighorn	4.19	0.54	4.73	90.02	11.78	101.80
Booth	0.57	0.00	0.57	12.28	0.00	12.28
Buck	4.98	3.18	8.16	98.95	66.99	165.95
Buffer	5.49	4.23	9.71	107.72	92.73	200.44
Game	6.50	1.96	8.47	135.19	45.98	181.17
Upper Gore	5.90	0.80	6.70	125.16	18.38	143.54
Grouse	8.93	2.90	11.83	205.76	70.47	276.23
Middle	6.28	2.54	8.82	130.50	58.27	188.76
Nottingham	2.40	3.54	5.94	53.19	77.90	131.10
Pitkin	0.51	0.00	0.51	40.13	0.00	40.13
Mill	9.31	0.00	9.31	202.73	0.00	202.73
Red Sandstone	4.43	7.75	12.18	86.46	170.22	256.68
Spraddle	3.73	0.48	4.21	83.98	11.44	95.42
Stone	5.08	3.65	8.73	108.61	86.42	195.02
Timber	4.85	0.68	5.52	109.70	15.12	124.82
Total	73.14	32.25	105.39	1,590.39	725.68	2,316.08

The underlying assumption is that a direct relationship exists among riparian disturbance, CDA, SNE, and stream health. This also implies that, at some quantifiable level of disturbance, stream health would become degraded below the robust health class. Existing disturbed areas within the WIZ were measured by the Forest Service (2003b) to determine baseline conditions and as the basis for assessment of the effects of the proposed treatments on riparian condition.

The assessment of CDA, SNE, stream health, and disturbance in the WIZ on NF administered lands within the project area is summarized below. Roads in the Vail, Avon, and Eagle-Vail urban areas were not surveyed, even though portions of these towns are located within the project area watersheds.

The existing CDA in the project area is 24.7 miles of roads that drain directly into the WIZ of streams. Of the 15 watersheds surveyed, six exceed the WCP handbook's design criterion of 10 percent SNE (**Table 3–17**). Mill Creek has the most CDA, both in acres and length of road that extends the stream channel network. Timber, Red Sandstone, and Mill Creeks have a high density of connected roads in the headwaters that access old timber harvest units. Connected road density in Game, Stone, and Mill Creeks is located along access roads in the Beaver Creek and Vail ski resorts. CDA in Spraddle Creek is primarily caused by one road located along the southeast side of the stream.

Table 3–17 Existing CDA and SNE in Project Area Watersheds

Watershed	Connected Disturbed Area (acres)	Stream Network Expansion[1] (Percent change in km/km^2)
Bighorn	0	0
Booth	0	0
Buck	0.5	4
Buffer	0.5	2
Game	6.3	**46**
Upper Gore	0	0
Grouse	0.5	0.6
Middle	0.1	0.5
Nottingham	0.3	3
Pitkin	0	0
Mill	20.7	**119**
Red Sandstone	14.9	**24**
Spraddle	0.7	**11**
Stone	6.3	**37**
Timber	1.3	**15**

[1] SNE is expressed as kilometers per square kilometer (km/km^2). Values shown in bold represent watersheds where the WCP handbook's design criterion of 10 percent SNE is exceeded.

Although roads are the largest source of existing CDA in the project area, other disturbances associated with landslides contributed sediments in Whiskey, Nottingham, and Buck Creeks. In most watersheds, urban development located downstream from the proposed project is a large source of CDA. Other areas with ground disturbance in the project area include ski runs, old timber harvest units, trails, and sheep grazing allotments. Ground disturbance on ski runs is limited to the headwaters of Game, Stone, and Mill Creeks. Grazing may increase sediment and unstable banks, and may be reflected in the stream health measurements. Grazing allotments are located in several watersheds, including Grouse, Buffer, Red Sandstone, and Middle Creeks. Field observations have indicated that more sediment has been contributed by open roads in use than by closed roads associated with previous timber sales.

There is a relationship between CDA and the percentage of the streambed surface covered in fine sediment (the key factor in assessing stream health). It appears that robust stream health is not maintained in reaches with a CDA of greater than 0.5 to 1.2 acres per square mile. There is a similar relationship between fine sediment and percentage increase in SNE caused by roads. Robust stream health is not maintained in streams with an increase in SNE greater than about 13 to 28 percent.

Six of the 15 streams surveyed do not meet the standard for robust stream health. Spraddle and Red Sandstone Creeks have a nonsupporting stream health class due to fine sediment. Buffer Creek has slightly impaired stream health (supporting) due to fine sediment. Mill Creek has a nonsupporting stream health class due to unstable banks and sediments. Ptarmigan Creek, a tributary of Mill Creek, is affected by deposition of fine sediment. Game Creek has a nonsupporting stream health class due to deposition of fine sediment.

The data show that Grouse and Buck Creeks contain unstable banks and Nottingham Creek contains fine sediments, characteristics that degrade these streams. However, natural processes contribute to the conditions of these streams, and must be considered in an evaluation of stream health. It is unclear if an appropriate reference habitat is available for the limestone geology of Grouse Creek. The stream health class of Nottingham Creek cannot be determined due to uncertainty about the channel type. The affected reach of Buck Creek is located in an urbanized area and is not on NF administered land. In addition, unstable slopes in the Nottingham and Buck Creek watersheds may be contributing to the high inputs of sediments to these creeks.

Environmental Effects

Direct and Indirect Effects by Alternative

Proposed activities may affect stream health and riparian conditions. The effects on stream health and riparian conditions would include the potential to impact aquatic life (designated beneficial use of the streams in the project area), in-stream habitat, and bank stability by mechanically clearing or burning vegetation and increasing surface runoff, soil erosion, and sediment yield to streams.

This assessment is based on the analysis indicators and estimates of the intensity, duration, and magnitude of proposed disturbances under each alternative. These factors are defined below.

- Intensity = type of disturbance
- Duration = period of disturbance (i.e. operations) and rate of recovery following disturbance
- Magnitude = Connected Disturbed Area (CDA) and Stream Network Expansion (SNE)

Alternative A – No Action

Under Alternative A, the No Action alternative, in the absence of significant and widespread disturbance, CDA and SNE would remain at or near current levels over the short-term in undisturbed areas, previously burned areas, existing forest treatments, and developed areas, including existing roads and trails. Water quality in the project area would not change. However, in the event of an intense wildland fire, soil and ash could reach streams in a quantity that would degrade water quality.

Disturbances such as wildland fires or MPB-induced mortality of 30 to 70 percent or more of the larger lodgepole pine across the landscape may decrease vegetation cover, evapotranspiration rates, and soil permeability, thereby increasing precipitation runoff volumes, soil erosion losses, and sediment yield in the short-term. Under current conditions for forests and shrublands, wildland fires could ignite in the project area or burn into the area. The effects would depend on the intensity and severity of the fire, the

portion of the watershed burned, the timing and intensity of precipitation and runoff following the fires, the erosion controls and other remedial measures implemented, and the rate of vegetation recovery. For example, the Forest Service conducted an interdisciplinary analysis of the 2002 Hayman fire; nearly total destruction of the litter layer was observed in high-severity burn areas and the threat of erosion in these areas was relatively high. In contrast, low-severity fires did not completely consume surface plant litter and were often found in a complex mosaic with unburned area, reducing soil erosion from these areas (Graham 2003).

When severe fires encroach on the water influence zone (WIZ) or a significant portion of a watershed is severely burned, slope failure, soil erosion, and increases in the volume and timing of peak flows can occur. These actions increase the transportation of sediments to streams and rivers, thus adversely affecting aquatic life and riparian conditions. Typically, nutrient loading and stream temperature increase with increasing sediment load to streams. As a result, the concentration of dissolved oxygen in water may decline from excessive algal growth and decay where streams are severely impacted by sedimentation following a wildland fire. Macroinvertebrate populations and fish spawning habitat also may decline due to the covering of stream gravels with fine sediment.

In the absence of significant and widespread disturbance, such as wildland fire or MPB infestation, the factors affecting soil erosion, sediment yield, the volume and timing of peak flows, channel stability, and aquatic habitat would not change over the short-term. Soil erosion would continue at current rates over the short-term. Impacts to stream health and riparian conditions resulting from existing urban and ski area development, highway maintenance, roads, past harvest activities, and fires would continue. Stream channels, existing roads, and road/stream crossings that are currently unstable would continue to degrade over the next several decades in the absence of additional erosion and sediment controls. Changes in vegetation vigor, composition, and structure due to increasing stand maturity may alter the hydrologic properties of existing vegetation communities over time. The aging of stands may reduce vegetation cover and evapotranspiration, contributing to soil erosion, runoff, and sediment yield, which could have detrimental effects on stream health and riparian conditions.

Alternative B

Proposed treatment activities would include construction of temporary roads, thinning and harvesting and/or sanitation and salvage of lodgepole pine, aspen thinning and patch cuts, removal of conifers from aspen stands, and fuels treatments consisting of mechanical treatments and prescribed fire in aspen communities and shrublands. These treatments are designed to reduce wildland fire hazards and reduce the risk of future MPB outbreaks. The proposed treatments generally remove or modify the vertical and lateral distribution of fuels and reduce the density of trees infected or killed by MPB or susceptible to attack. Wildland fire hazards would be reduced. The severity or extent of wildland fires could be reduced under Alternative B.

The removal of vegetation by thinning, patch cuts, sanitation, and salvage in lodgepole pine, patch cuts and thinning in aspen, and the burning of shrublands with and without aspen, may increase water yield due to soil compaction or reduced evapotranspiration and soil permeability. In the absence of the BMPs and design criteria described in **Appendix D**, which would include limits on soil compaction, these effects could increase the transport of sediments to perennial and intermittent streams and could damage aquatic habitats by increasing peak flows that cause erosion of the stream bed and banks. Aquatic life also could be degraded by migration barriers, changed flow regimes, riparian damage, or large sediment or chemical loads. However, BMPs and specific design criteria to reduce soil compaction and sediment transport would be implemented. The amount of sediment transported to streams would depend on the location of the sediment source zone and the sediment transport efficiency in the watershed.

Flow increases would represent a very small increment of the total water yield and would be difficult to measure in larger watersheds. Flow increases would not become significant until about 25 percent of the basal area of a forested watershed is cut (FSH 2509.25). While 30 to 50 percent, and possibly up to 70 percent of the basal area would be cut in the lodgepole pine treatment units, these units cover only 700 acres, and represent much less than 25 percent of the basal area of the affected forested watersheds.

Analysis indicators were selected to assess the location of the proposed treatments in relation to a WIZ consisting of vegetated buffers along stream channels. Disturbances within the WIZ were measured using the analysis indicators for streams and watershed, CDA, and SNE. CDA and SNE were used to predict the third analysis indicator, stream health class. Forest Plan standards for water and riparian resources require that land treatments protect long-term stream health from damage by maintaining or improving stream health toward the robust stream health class. Only actions that maintain or improve long-term stream health and riparian ecosystem conditions are allowed in the WIZ. CDA and SNE capture the potential effects that the proposed treatments could have on stream health class because of their relationship to increased runoff, soil erosion, and sediment yield caused by various types of disturbances.

Alternative B would include the potential for an increase in CDA in eight of the nine watersheds to be affected by the proposed project. However, BMPs and design criteria that would be implemented for prescribed fire would require either not burning in the WIZ, or keeping the burn cool to maintain a soil duff layer. Therefore, burns adjacent to streams would not be considered to be connected disturbed areas and would not increase the CDA over the existing condition.

In the absence of BMPs and design criteria, potential CDA in four watersheds could exceed the existing CDA. If the proposed disturbance associated with treatment units in Game Creek, Metcalf Creek, Nottingham Creek, or Red Sandstone Creek were to encroach on the WIZ, CDA would increase. However, BMPs and design criteria that prohibit treatment activities in the WIZ would be implemented, which would avoid the creation of additional CDA and maintain stream health class at existing levels in these watersheds.

SNE in the Grouse Creek watershed would increase by 1 percent due to the construction of a temporary road to reach Unit 116 above National Forest System Road (NFSR) 749.1 and West Grouse Creek. The total increase in SNE in the Grouse Creek watershed would be almost 2 percent, which is below the WCP handbook's design criteria of 10 percent SNE. In addition, effects would be short-term, since the temporary road would be decommissioned following use. Therefore, the stream health class of West Grouse Creek would not change due to implementation of Alternative B, BMPs, and design criteria described in **Appendix D**.

Of the 15 streams described within the project area, the stream health class of nine potentially could be affected in the absence of BMPs or design criteria. Four of the nine streams are currently not meeting the standard for robust stream health due to fine sediments. The four streams are Game Creek, Red Sandstone Creek, Spraddle Creek, and Stone Creek.

Game Creek is located along and above trails in the vicinity of the Vail ski resort, and its uppermost reach is located near a private road. Increases in unstable banks along this drainage have coincided with urban developments near the mouth of the watershed, below Unit 313. Although Game Creek currently is not meeting the standard for robust stream health due to fine sediments, the proposed broadcast burn in Unit 313 is not likely to contribute noticeably to sedimentation in this drainage because of BMPs and design criteria that would be implemented to reduce sediment transport, and is unlikely to have an effect on the stream health class of Game Creek.

The reach of Red Sandstone Creek located below the stream gauge has non-supporting stream health due to fine sediment. The likely source of fine sediment in this stream reach is the road system located at the head of the watershed. This road system is above the potential effects of the proposed treatments in Unit 617. The lower reaches of Red Sandstone Creek, below the potential effects of the proposed treatments, all have robust stream health. The proposed treatments in Unit 617, cutting of aspen and conifers, followed by pile burning, are not likely to contribute noticeably to sedimentation in this drainage, and are unlikely to have an effect on the stream health class of Red Sandstone Creek because of BMPs and design criteria that would be implemented to reduce sediment transport.

The CDA in Spraddle Creek is primarily due to one road located along the southeast side of the stream, across the creek from the potential effects of Unit 619. The proposed treatments in Unit 619, cutting of aspen and conifers, followed by pile burning, are not likely to contribute noticeably to sedimentation in this drainage, and are unlikely to have an effect on the stream health class of Spraddle Creek because of BMPs and design criteria that would be implemented to reduce sediment transport.

Stone Creek is located along and below roads and trails in the vicinity of the Beaver Creek ski resort. Existing SNE in Stone Creek is high, but stream health for fine sediment is robust. The proposed disturbance required to widen the Stone Creek Trail (FDT 2349) to accommodate log hauling would not be located within the WIZ, although the trail crosses an intermittent stream course below Unit 101 that is smaller than a third order stream, the smallest feature that would be characterized as a WIZ. This temporary road and the proposed treatments in Unit 101 through Unit 106 are not likely to contribute noticeably to sedimentation in this watershed, and would be unlikely to have an effect on the CDA, SNE, or stream health class of Stone Creek. Sediment transport would be limited by the location of the temporary road away from the drainage along a terrace, and other BMPs and design criteria that would be implemented.

Transport of sediment eroded from the treatment areas to streams would be minimized by prohibiting activities other than identified drainage crossings inside the WIZ. Disturbed sites would be revegetated following cessation of activities to prevent runoff and sedimentation. To further minimize effects on stream health and riparian conditions, the BMPs and design criteria described in **Appendix D** would be implemented. These would include slope stability and erosion control measures and sediment controls, such as:

- Limiting road construction and equipment in the WIZ and prohibiting patch cuts, landings, skid and tractor trails, severe burning, and pile burning in the WIZ. When this is not practical, constructing designed stream crossings to safely pass stream flows and flows associated with storm events, and constructing and restoring crossings to prevent headcutting, gullying, erosion, aggradation of the channel, or sediment transport to ephemeral or perennial channels. Installation of crossings would occur when there is minimal water flowing in the stream channels to limit erosion and water quality impacts.
- Locating the majority of the proposed temporary roads on low-angle slopes where the erosion potential and the area of exposed cut and fill slopes can be minimized.
- Emptying cross drains into vegetated filter strips to trap sediment where needed, and where road drainage is located in the WIZ, surfacing roads with gravel, constructing sediment traps, or windrowing slash.
- Constructing check dams in tributary drainages above the 100-foot buffer zones using straw bales at natural sediment deposition locations where sediment could be transported to intermittent and perennial drainage channels.
- Utilizing a greater frequency of smaller waterbars.
- Re-contouring, as needed, and revegetating temporary roads and tractor trails after use.

- Avoiding continuous disturbance that would provide a conduit for routing sediment to streams by constructing cross-drainage or drainage relief.
- Designing prescribed burns so that excessive sedimentation does not occur.

All temporary roads and landings would meet the design criteria and BMPs described in **Appendix D** and the Forest Service WCP handbook to minimize the long-term effects of road and landing construction on sedimentation and water yield. The implementation of these measures would not necessarily ensure that effects on stream health and riparian conditions in the project area can be eliminated. However, these BMPs and design criteria, when comprehensively and effectively applied, should reduce the likelihood of sedimentation to streams due to the implementation of proposed activities.

The amount of sediment entering streams from temporary roads and treatment units would not change the current condition of water quality. Soil erosion and erosion of ash from burned areas can be a source of degraded water quality; however, the avoidance of the WIZ and implementation of design criteria and BMPs would reduce sediment transport and prevent most sediment from reaching streams.

Alternative C

The effects related to streams and watershed would not be expected to vary from those described under Alternative B, with one exception. Alternative C would not have the potential to affect the WIZ along Stone Creek due to use of temporary roads that access the upper portions of Units 101 and 102 from above and the implementation of the BMPs and design criteria described in **Appendix D**. The temporary access to Units 101 and 102 under Alternative C would result in 2 additional acres of disturbance on slopes above Stone Creek

Alternative D

The effects related to streams and watershed would not be expected to vary from those described under Alternative B, with one exception. Fewer acres would be treated under Alternative D, which would reduce the potential for effects on the WIZ, CDA, and SNE to occur. Increases to CDA and SNE would be prevented by the implementation of design criteria and BMPs described in **Appendix D**.

Cumulative Effects by Alternative

Alternative A – No Action

Effects from ongoing soil-disturbing activities on public and private lands and future activities on private lands within the project area would contribute to cumulative impacts on streams and watershed resources in the project area. The impacts from urban development on private lands are evident and are likely to become more evident over time. The effects of most prior management activities on NF administered lands on stream health in the project area have been documented and are primarily related to roads, trails, and recreation facilities, including Vail and Beaver Creek ski resorts. The effect of the existing road system on streambed sediment was measured in Stone and Grouse Creeks in 2002 (USFS 2003b). Stream health for fine sediment is robust in both streams, with substrate conditions comparable to that found in reference streams.

Roads, trails, ski trails, highway maintenance (e.g. sanding along I-70 for traction), and urban developments are contributing to relatively high levels of runoff, erosion, and sedimentation to streams. The number of skier visits at the two resorts has increased 45 percent in the last 15 years. Therefore, facilities on NF administered lands and private housing developments will likely increase in the foreseeable future. Newly constructed facilities at the ski resorts and on private lands will continue to make the largest contributions to stream sedimentation in the project area for the foreseeable future. The

demand for new construction on private lands in the project area will continue to rise as it did for the period 1990 to 2000.

Table 3–40 in the Vegetation section of this chapter identifies past activities in the project area. The cumulative effects of these activities on streams and watersheds should be short-lived, based on the effective and comprehensive implementation of design criteria described in **Appendix D**, implementation and maintenance of BMPs during treatment activities, and reclamation following activities. This impact to streams and watersheds in the project area should be small in comparison to the contribution from ongoing and reasonably foreseeable construction on private lands, described above.

Alternative B

The cumulative effects for Alternative B would vary only slightly from those described above for Alternative A – No Action. These variations are described below.

The VVFH project would add to past and ongoing activities on NF administered lands. Most effects from the proposed treatments would be localized in the vicinity of the treatment units due to the implementation of design criteria and BMPs that would reduce the transport of sediment and prevent most project-related sediment from reaching streams that are downgradient of the proposed treatments. Reasonably foreseeable Forest Service management activities in the project area would not be expected to contribute to cumulative conditions that would not meet Forest Plan guidance. Possible re-entry after 10 years into the lodgepole pine treatment units where ladder fuels need treatment or not enough basal area was removed under Alternative B to effectively modify future mountain pine beetle (MPB) risk would not be expected to result in cumulative conditions that would exceed the project-only effects, provided design criteria and BMPs comparable to the measures described in **Appendix D** are followed during re-entry treatments. With the implementation of sediment and erosion control measures for the proposed treatments, stream sedimentation rates should diminish.

The cumulative effects of the proposed project on streams and watersheds should be short-lived, assuming the effective and comprehensive implementation of design criteria and BMPs during treatment activities, and reclamation following activities. Impacts to streams and watersheds in the project area should be small in comparison to the contribution from ongoing and reasonably foreseeable construction on private lands, described above. The site-specific layout of treatment units with respect to stream buffers (WIZ) and implementation of design criteria and BMPs would limit sedimentation of streams.

Alternative C

The cumulative effects for Alternative C would not be expected to vary from those described above for Alternative B.

Alternative D

The cumulative effects for Alternative D would not be expected to vary from those described above for Alternative B.

Forest Plan Consistency

The action alternatives, when combined with management requirements, such as project design criteria, BMPs, and watershed conservation practices, would be consistent with Forest Plan guidance. Long-term stream health in the project area depends, in large part, on improving ecosystem health and reducing the potential effects of future disturbances, such as a MPB outbreak, or a severe wildland fire such as a large stand-replacing fire. The potential effects of a large wildland fire on water quality and stream health

would be considerable. The action alternatives would produce short-term, temporary effects on streams and watersheds that would not affect existing CDA or SNE. These alternatives also would improve forest health and reduce the risk of future outbreaks of MPB in treated stands. These actions could reduce the potential effects of a large stand-replacing fire and would contribute to the maintenance of stream health over time. The Forest Plan standards for water and riparian resources focus on conditions over time by requiring that land treatments protect long-term stream health from damage by increased runoff and sedimentation. Management actions within the Forest also must maintain or improve stream health towards the robust stream health class. This Forest Plan guidance regarding stream health would be met over the short-term by the implementation of design criteria and BMPs, and over the long-term, by the improvement of forest health conditions.

Only actions that maintain or improve long-term stream health and riparian ecosystem condition and identified stream crossings are allowed in the WIZ in compliance with Forest Plan standards. The temporary road in the WIZ for West Grouse Creek under all action alternatives (Alternatives B, C, and D), the temporary road near the WIZ along Stone Creek under Alternatives B and D, and the temporary access to Units 101 and 102 on slopes above Stone Creek under Alternative C all would maintain stream health and contribute to improving forest health and reducing the risk of future outbreaks of MPB over the long-term.

Irreversible And Irretrievable Commitments

There are no irreversible commitments as a result of any of the action alternatives. However, under the No Action alternative, there would be an increase in the buildup of natural fuels and the associated wildland fire hazards. Resulting watershed effects from wildland fires could become increasingly difficult to reverse.

Any noticeable watershed impacts related to the action alternatives would be short-term, and should have no long-term consequences. Short-term effects on water quality or stream health during project activities would represent an irretrievable commitment of resources.

3.2.3 Geology and Soils

Resource Description

Changes to earth materials can have profound effects on the human environment. Disturbances from various causes such as MPB, wildland fire, or management activities can affect the characteristics of slopes and soils, and influence soil productivity, soil movement, compaction, and slope stability in different ways. Changes caused by surface disturbing activities can trigger new landslides or reactivate existing ones. Project activities have the potential to reduce the stability of slopes and cause slope failure, which could increase soil erosion and sedimentation to streams and rivers. Increased soil erosion has the potential to create debris flows or flooding that could damage private property and transportation corridors. Project activities could also potentially affect the productivity of soils because of accelerated wind and water erosion, compaction, and coarse woody debris (CWD) management.

Indicators

- Soil disturbance during project activities, in acres
- Effects on areas of slope hazards and existing landslides
- Acres of treatments in areas of slope hazards, existing landslides, and sensitive soils
- Effects on erosion and sedimentation

- Expected soil erosion from treatment areas in tons per year and tons per acre per year; post-treatment and 20 years later

Forest Plan Direction

The overall direction for managing geology and soils, including geologic hazards such as slope stability, on the WRNF includes the regional goals of protecting basic soil, air, water, and land resources and providing for multiple uses and sustainability of national forests and grasslands in an environmentally sound manner (Forest Plan, page 1-1). Forest-wide standards for soils include the following management requirements (Forest Plan, pages 2-4 and 2-5):

- Stabilize and maintain roads and other disturbed sites during and after construction to control erosion.
- Limit roads and other disturbed sites to the minimum feasible number, width, and total length consistent with the purpose of specific operations, local topography, and climate.
- Construct roads and other disturbed sites to minimize sediment discharge into streams, lakes, and wetlands.
- Reclaim roads and other disturbed sites when use ends, as needed, to prevent resource damage.
- Manage land treatments to maintain or improve soil quality, limiting the sum of detrimental soil impacts to no more than 15 percent of an activity area.
- Maintain or improve long-term levels of organic matter and nutrients on all lands.
- Design vegetation and fuels management treatments to retain the average per-acre levels of CWD of 5 tons per acre in lodgepole pine and 3 tons per acre in aspen, calculated as per-acre averages for each 1,000 acres over a silvicultural landscape assessment area.

Forest-wide guidelines for slope stability (Forest Plan, page 2-5) contain the following management guidance:

- Conduct an onsite slope stability exam in areas identified as potentially unstable. (Potentially unstable land is described as having a “high” or “very high” instability ranking or classified as “unstable” or “marginally unstable.”)
- Limit intensive ground-disturbing activities on unstable slopes identified during examinations.

Forest-wide guidelines for soils (Forest Plan, pages 2-5 and 2-6) include the following management guidance to minimize soil impacts for vegetation management activities:

- Use practices other than brush rake piling and crushing by heavy equipment to dispose of slash.
- Limit the width of skid trails to 12 feet and spacing between trails to no closer than 120 feet on average.

Desired Condition

The Forest Plan identifies no explicit desired condition for geology. However, the dynamic and varied geology in the project area plays a central role in meeting MA goals related to sedimentation to streams and rivers. Therefore, the desired future conditions stated for watershed resources directly apply to slope stability and relate to the desire to avoid intensifying slope stability hazards in the project area. The Forest Plan outlines the desired condition for soils, including acceptable limits of change for detrimental soil disturbance, compaction, and the requirement that management activities be designed and implemented to maintain or improve the long-term soil productivity potential of the Forest (Forest Plan, page BB-10). The Forest Plan specifies that the managed land treatments are to limit the sum of detrimental soil impacts to no more than 15 percent of an activity area.

Temporal Scope

This analysis considers existing conditions and projected conditions immediately following implementation of the proposed treatments and 20 years following the proposed treatments.

The greatest change in factors influencing slope stability, soil erosion, and compaction would occur immediately following implementation of the proposed treatments. As time passes, the magnitude and intensity of these effects would decline as disturbed areas are reclaimed. Breakdown of soil crusts that were caused by prescribed fire, and mechanical breakdown of soil compaction by freeze-thaw action and possible site treatment mitigations also would lessen the effects over time.

Geographic Scope

The project area boundary includes the Gore Creek watershed and a portion of the Eagle River watershed. In Gore Creek, the project boundary extends west from Vail Pass to the confluence with the Eagle River. In the Eagle River, the project boundary extends from the mouth of Cross Creek near Minturn, to McCoy Creek below the town of Avon. Gore Creek has a drainage area of more than 100 square miles, while the Eagle River above Avon has a drainage area of more than 420 square miles.

Affected Environment

Geology

The geology resource description concentrates on the factors that influence landslide hazards in the treatment areas and the potential effects of proposed treatments on the potential for and occurrence of slope failure.

The majority of the treatment units and temporary roads in all action alternatives are located upslope, within, or adjacent to existing landslide areas and areas designated as moderate and high landslide hazard areas. Existing landslides and landslide hazard categories are described and mapped by Moser (2002). The known and documented landslides in the Dowds Junction Area (Whiskey Creek, Meadow Mountain, Dowds No. 1 and No. 2 Landslides) are mapped and described by Jochim et al. (1988) and Rogers (2004). A slope stability map previously developed by the WRNF used six landslide hazard categories: Slight, Low, Moderately Low, Moderately High, High, and Severe. Moser (2002) simplified the hierarchy of landslide hazard categories to three: low, moderate, and high.

The locations of the existing landslides and areas classified as low, moderate and high landslide hazard areas relative to the location of the proposed treatment units and the bedding attitudes of geologic formations are shown on **Figure 3–1**. The landslide hazard categories shown on **Figure 3–1** are relative in the sense of more or less susceptibility. Rock falls were not considered since the factors that influence rock falls (i.e. steep slopes, prominent outcropping, and weathering of rock) are not normally affected by the proposed treatments. Some criteria that contribute to landslides (compression loads and soil moisture) can be affected by forest treatments. The landslide hazard categories were based on the criteria provided in **Table 3–18**.

Figure 3–1 Landslide Hazard Categories

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Table 3–18 Landslide Hazards

Geologic Type	Hazard Categories		
	High	Moderate	Low
Cross Creek	Slope gradient >60 percent	Slope gradient 25-60 percent	Slope gradient <25 percent
Sawatch	N/A	Slope gradient >25 percent	Slope gradient <25 percent
Minturn and Maroon	Slope gradient >20-30 percent on dip slopes parallel to bedding Slope gradient >60 percent on slopes with significant colluvial/soil depth.	Slope gradient < 20-30 percent on dip slopes parallel to bedding Slope gradient < 60 percent on slopes with significant colluvial/soil depth Slope gradient >25 percent, all other slopes	Slope gradient <25 percent, all slopes excluding moderate and high categories

These hazard categories were based on correlation of existing landslide features, relict or current, with topographic and geologic landslide factors that could be readily observed or measured in the field, from aerial photography, and maps.

Rotational and translational slides and debris flows have occurred in the project area. Both features are initiated in saturated soil or colluvium on a steep slope. Slides begin and continue movement on a distinct shear surface that usually forms a relatively impervious layer to the downward percolation of water. This surface may be a bedding plane in solid rock, or layers within a soil mantle, such as a clay lens. Slides may break up down slope into multiple blocks with independent movement, or even eventually break down to spread laterally, resembling a flow. When the dip of the bedding plane is generally in the same direction as a hill slope, the slope is further destabilized over whatever effect gravity and gradient imposes. Debris flows constitute a potential threat to life and property because of their rate of movement and the location of property development in the Gore Creek valley underneath hill slopes that may be considered high-risk for debris flows.

High-hazard areas include hill slopes with dip slope bedding orientation and gradients over 20 to 30 percent, and gradients over 60 percent on slopes with some significant accumulation of colluvial material or soil. Moderate-hazard areas include dip slope bedding orientation on hill slopes less than 20 to 30 percent, and all slopes above 25 percent that have little or no accumulation of soil or colluvial material. Low-risk areas include valley bottoms and ridge tops with slope gradients under 25 percent that do not meet criteria for moderate- or high-risk categories.

Mass movement of soil and geologic material occurs when the stresses acting on hill or valley side slopes exceed the strength of the material involved. This is typically expressed as a factor of safety (Fs) where:

$$Fs = \frac{\text{Strength or shear resistance of material}}{\text{Magnitude of stress}}$$

When the Fs is less than 1, the slope will fail, and movement of soil and geologic material will occur. By implementing the proposed treatments, the Fs of the surface geologic formation and the soil mantle may

decline due to increases in weight - loading (surcharge) and porewater pressure, and the removal of lateral support of the slope (i.e. undercutting and steepening of slopes). This may occur due to the following:

- Increased soil moisture and the duration of soil saturation resulting from the decline in evapotranspiration from the removal or burning of trees and shrubs
- Increased snow accumulation on the slopes where lodgepole pine and aspen have been patch cut
- Increased runoff, concentration of precipitation, erosion, and weight-loading caused by removal of vegetation, reduced permeability from burning, and soil compaction from roads, landings and tractor and skid trail cuts and fills
- Reduced lateral slope support from road cuts and tree and shrub root death

These factors may increase the potential for accelerated movement of existing landslides and initiation of new landslides unless project design criteria and best management practices (BMPs) reduce their influence on slope stability.

Soils

The description of the soils resource forms the basis by which to assess the intensity, duration and magnitude of soil impacts associated with the proposed treatments, and to develop effective mitigation measures that prevent, reduce, or eliminate impacts to soil resources. The primary impacts to the soil resources would be losses in soil productivity in large part caused by increased potential for wind and water erosion, soil compaction, and coarse woody debris (CWD) management. According to Forest Plan Soils Standard No. 5, the managed land treatments must limit the sum of detrimental soil impacts to no more than 15 percent of an activity area. Potential soil impacts related to the proposed treatments are excessive soil compaction, displacement, erosion and loss of CWD associated with temporary roads, skid and tractor trails, and pile burning.

Characteristics of the dominant soil map units (soil MUs) within the proposed treatment units are provided in **Table 3–19.** Potential effects on soil resources are influenced by the ecological land units where soils occur and are dependent on the sensitivity and limitations of the soils.

Thirty different soil MUs larger than 1 acre in size occur within the proposed treatment units. Six other soil MUs also occur within the proposed treatment units, however, these MUs account for less than 6 acres (0.2 percent) of the treatment units and no sizeable portion of any of the treatment units occurs within these MUs. Soil MUs are described and mapped in the WRNF's report titled DRAFT - *Soil and Ecological Land Unit Survey Holy Cross Area, Colorado* (USFS 1995). The sensitivity of soils and their dominant limiting factors relating to the proposed treatments were developed based on the soil MU descriptions. Forest staff field notes and green cards used to document field-level project designs, and the draft soil survey report (USFS 1995) may be reviewed in the *Project File*. Soils sensitive to erosion or compaction are shown in **Figure 3–2**.

Soils were classified as sensitive if they met one or more of the following criteria:

- A severe water erosion hazard
- A poor natural drainage class or slow permeability
- Rapid runoff
- Depth to seasonal high water table of less than 1 foot
- Cut and fill slope stability rating of severe due to erosion hazard
- Rating of "poor" or "severe" due to erosion hazard from unsurfaced and improved roads, off-road vehicle traffic, and trails
- Revegetation limitation rating of poor or severe due to erosion hazard

Table 3–19 Soil Limitations and Overall Sensitivity to Water Erosion and Soil Compaction

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Figure 3–2 Sensitive Soils

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Environmental Effects

Direct and Indirect Effects by Alternative

Proposed activities may affect slope stability and soil productivity. Slope stability effects would include the potential loss of property caused by accelerated movement of existing landslides and the initiation of new landslides. Soil productivity effects would include increased soil erosion and compaction, and reduced CWD and nutrient status of soils.

This assessment is based on the analysis indicators and estimates of the intensity, duration, and magnitude of proposed disturbances under each alternative. These factors are defined below.

- Intensity = type and location of disturbance
- Duration = period of disturbance and rate of recovery following cessation of operations
- Magnitude = area of land affect by the proposed activities

Alternative A – No Action

Geology

Geologic effects focus on the factors that influence landslides and slope hazards in the treatment areas and the potential effects of proposed treatments on slope failures. In the absence of significant and widespread disturbance, such as wildland fire or MPB infestation, slope stability would remain at or near current levels over the short-term in undisturbed areas, previously burned areas, existing treatment areas, and existing roads.

Rotational and translational slides and debris flows have occurred in the project area and would be expected to occur in the future where slope hazards and landslides exist. The following internal causes of landslides apply to the project area: increase in water content; weathering of rock material; expansion of clays; and water seepage along dip slopes or other piping. The sizes of existing slides vary greatly, from a few tens of feet to complexes with multiple slide blocks over down slope distances of hundreds or more feet. Future slides would be comparable in size. Landslide colluvium of Quaternary age covers significant areas within the boundaries of the Minturn Formation and its presence is well correlated with down slope dips in bedding orientation. The down slope dip of the Minturn Formation in the vicinity of Whiskey Creek is one of the steepest in the project area and may account for the instability of this area. Nearly the entire Whiskey Creek drainage is contained within an existing landslide, which has an overall appearance of recent origin and an immature stage of development.

Slides and debris flows both would be initiated in saturated soil or colluvium on a steep slope. When the dip is generally in the same direction as a hill slope, the slope would be further destabilized over whatever effect gravity and gradient imposes. If sufficient soil mantle or otherwise loose material exists on the hill slope, particularly up slope of a seep, then landslides or debris flows could occur.

Slides would begin or continue movement on a distinct shear surface that usually forms in a layer that is relatively impervious layer to the downward percolation of water. This surface may be a bedding plane in solid rock, or layers within a soil mantle, such as a clay lens. In bedding layers that are relatively impervious to downward movement of water, water would most likely travel along bedding planes and form a seep at the surface contact. Slides may break up down slope into multiple blocks with independent movement, or eventually break down into a chaotic admixture that spreads laterally, resembling a flow.

The factors affecting the movement of existing landslides and the initiation of new landslides would not change over the short-term. However, because of increasing stand maturity, changes in vegetation vigor, composition, and structure may alter the hydrologic and geotechnical properties of existing vegetation communities over time. These effects of aging stands may reduce lateral slope support and increase soil saturation, thereby increasing the surcharge on slopes over the long-term. Runoff would increase due to reductions in evapotranspiration, root structure, soil organic matter, and duff. These effects of aging stands may eventually increase the frequency and magnitude of slope failure.

Decreases in vegetation vigor associated with increasing stand maturity and increases in beetle-killed trees would probably result in increased infiltration of precipitation. The increased weight of earth materials due to water content alone might induce movement. Movement also may be induced by an increase in soil pore pressure, which acts to reduce shear strength, or an increase in percolation of water along "piping" through a failure zone.

The destruction of vegetation in a wildland fire would increase infiltration and runoff of precipitation abruptly and dramatically. This increase in water content and seepage would increase slope hazards. Slope movements after a wildland fire could have effects similar to those described above for increasing stand maturity and beetle-killed trees; however, the abrupt increase in water content on slopes likely would cause more immediate and more pronounced slope movements. The intensity of these effects likely would be more pronounced also, increasing the potential for damage or injury caused by slope movements.

Soils

In the absence of significant and widespread disturbance, such as wildland fire or MPB infestation, soil productivity and erosion would remain at or near current levels over the short-term in undisturbed areas, previously burned areas, existing treatment areas, and existing roads. However, under current forest conditions in the project area and surrounding areas, wildland fires could ignite in the project area or burn into the area. If a wildland fire were to occur, soil erosion could initially be very high. Wildland fires can lead to soil erosion on a massive scale and increase sedimentation to streams and rivers, thus adversely affecting water quality and aquatic and riparian habitat. The duration of these impacts would depend on the intensity and severity of the fire, the timing and intensity of precipitation and runoff, the erosion controls and other remedial measures implemented, and the rate of vegetation recovery. Soil erosion would vary according to the location and severity of the wildland fire.

For comparison, the potential soil loss from a large wildland fire could be three times the potential soil loss from prescribed fire based on model results in the vicinity of the Hayman fire (USFS 2003a), or about 9 tons per acre per year based on soil erosion estimates for prescribed fire treatments in this analysis (**Table 3–24** on page 3-44). Although soils in the project area would vary from those occurring in the area modeled, the project area contains sediments with slope stability hazards, and the estimated soil loss from a wildland fire in the project area would not be expected to be less than the modeled area. An estimated 24,000 acres, or nearly one-third of the project area, could burn in a large wildland fire. The estimated acreage was derived by identifying large, contiguous areas of lodgepole pine and spruce/fir vegetation types in the project area, and calculating the number of acres within these contiguous areas. A large wildland fire in the project area could produce 200,000 tons or more of sediment in the first year following the fire. An estimated 20 to 80 percent of the sediment eroded during the first year following a wildland fire could reach surface drainages, depending on the location of the burn and the effectiveness of mitigation measures for the emergency rehabilitation of burned areas.

When wildland fires dramatically raise the temperature of the ground surface or burn the near-surface soil horizon, significant alteration of the root systems, vegetation, surface litter, and soil organic matter can occur. This would expose of mineral soils to wind and water erosion, and increase runoff due to reduced evapotranspiration and permeability of near-surface soil caused by the formation of hydrophobic (water-repellent) soil. The duration of increased runoff soil exposure could vary considerably. For example, hydrophobic soil conditions may be relatively ephemeral and the growth of grasses, forbs, and wood shrubs may be quite vigorous after a fire. However, prior to the onset of these changes, high-intensity precipitation events following fires can result in severe soil erosion.

Wildland fire would temporarily increase soil nitrogen and phosphorus status. However, if the fire is severe, removal of soil organic matter, vegetation, and coarse woody debris (CWD) would likely reduce the overall nutrient status of the soil in the long-term. This would depend heavily on the pattern of fire severity across the landscape and the rate of vegetation recovery.

Increasing stand maturity, changes in vegetation vigor, composition, and structure may alter the hydrologic and geotechnical properties of existing vegetation communities over time. Runoff would increase due to reductions in evapotranspiration, root structure, soil organic matter, and duff. These effects of aging stands may eventually increase soil erosion.

The factors affecting rill and gully erosion and the advancement of existing gullies in slopes would not change. In the absence of significant and widespread disturbance associated with wildland fire, soil compaction on existing roads and trails would likely remain unchanged or increase as recreational use of the project area continues to increase and intensify. However, in undisturbed areas, existing forest treatment areas, and areas where wild and prescribed fires have previously occurred, soil compaction would probably decline over time due to freeze-thaw cycles, plant succession, expansion of plant root systems, and the accumulation of soil organic matter.

Without the significant and widespread disturbance associated with wildland fire, soil nutrients and CWD accumulation would probably increase in the long-term throughout the project area (with the exception of existing roads and forest treatment areas) due to the decomposition of plant litter, weathering of mineral soils, addition of organic matter from root systems, and continued soil development.

Under the No Action alternative, in the absence of significant and widespread disturbance, projected annual soil loss under the existing conditions in the project area would be 0.04 tons/acre/year (**Table 3–24** on page 3-44).

Alternative B

Effects on geology and soils under Alternative B would be related to the construction of temporary roads, thinning, patch cuts, sanitation, and salvage of lodgepole pine, aspen thinning and patch cuts, and fuels treatments consisting of mechanical treatments and prescribed fire in aspen communities and shrublands. These treatments are designed to reduce wildland fire hazards, enhance aspen fuelbreaks, and reduce the susceptibility of treated stands to future outbreaks of MPB. The proposed treatments generally remove or modify the vertical and lateral distribution of fuels, enhance aspen communities, and reduce the density of lodgepole pine infected by MPB or susceptible to attack. Forest treatments could potentially reduce the severity or extent of wildland fires.

Each type of surface disturbance (for example, lodgepole pine treatments, aspen treatments, temporary roads, cable corridors and tractor trails) was analyzed separately. The area that would be directly affected by each type of disturbance was estimated for each alternative and is summarized in **Table 2-2**. The amount of land directly affected by each type of disturbance may vary from that provided in **Table 2-2** by 15 percent. The potential effects of each alternative should generally vary in direct proportion.

Effects associated with wildland fires described under Alternative A – No Action also would apply to Alternative B, although under Alternative B the current forest conditions in the project area would deteriorate less in the long term than under Alternative A. Proposed treatments under Alternative B also could lessen the severity and extent of future wildland fires and decrease wildland fire hazards compared with Alternative A.

Geology

The occurrence of a wildland fire could activate or contribute to the activation of landslides or debris flows, or enlarge existing slope failures. However, under Alternative B the current forest conditions in the project area would deteriorate less in the long term than under Alternative A, potentially reducing future slope movements associated with deteriorating forest conditions. Proposed treatments under Alternative B also would lessen the severity of future wildland fires and decrease wildland fire hazards compared with Alternative A, which would limit increases in infiltration and runoff of precipitation after a wildland fire. An increase in water content of slopes and seepage after a wildland fire would increase slope hazards, however, the increase in slope hazards caused by wildland fire over time would be less under Alternative B than under Alternative A.

Proposed treatment activities under Alternative B could activate or contribute to the activation of new landslides, or enlarge existing landslides. Activation and enlargement of existing landslides or development of new landslides could cause significant damage to private property, structures, and the I-70 corridor, damming of the Eagle River, and possibly injuries. The majority of treatment units are located upslope or adjacent to medium and high slope hazard areas. Therefore, the proposed treatments could potentially impact and be impacted by landslides. Design criteria described below and in **Appendix D** would reduce the risk of slope movements in treatment units.

The causes of potential slope movements that could be related to lodgepole pine treatments would be undercutting or excavation at the toe of a slope by roads, addition of material on slopes by road fills, shocks and vibrations from equipment operation and tree felling, increased water content and removal of lateral support caused by the removal of trees and burning of vegetation, increased snow accumulation on the patch cut slopes, or the concentration of runoff by roads, landings, cable corridors and skid trails. The conditions of gradient and material mass must be present to initiate movement.

The design criteria described in **Appendix D** would be implemented to minimize slope movements that could be related to implementation of lodgepole pine treatment units. These design criteria for lodgepole pine treatment units would require avoidance of landslides and high slope hazard areas. Treatments would be designed in the field so that none would occur within 200 feet upgradient of existing rotational slumps and landslides, areas classified as high slope stability hazards, or prominent landslide features. Cutting would not occur on slopes that exceed a gradient of 60 percent. Upgradient of existing rotational slumps and landslides, large water collection points would be minimized by using a greater frequency of smaller water bars than that recommended in FSH 2509.25 – Watershed Conservation Practices Handbook. The implementation of these measures would not necessarily ensure that the hazards associated with increased movement of the landslides in the project area can be eliminated. However, these measures should reduce the likelihood of slope movements caused by the implementation of project activities.

The acres of proposed treatments located in existing landslides are shown in **Table 3–20** and the acres of proposed treatments located in slope hazard categories are shown in **Table 3–21**. Application of the design criteria in **Appendix D** would result in the avoidance or mitigation of effects on all landslides and high slope hazard areas.

Table 3–20 Treatment Units in Existing Landslides by Alternative (Acres)

Treatment Units	Alternative B	Alternative C	Alternative D
Lodgepole Pine (100s)	1	1	1
Aspen (200s)	90	90	40
Fuels (300s to 600s)	0	0	0

Note: All acreages are rounded off

Table 3–21 Slope Hazards by Alternative (Acres)

Slope Hazard Categories	Alternative B	Alternative C	Alternative D
Lodgepole Pine Treatment Units (100s)			
High	10	10	10
Moderate	360	360	360
Low	380	380	380
Total Acres (Lodgepole Pine)	750	750	750
Aspen Treatment Units (200s)			
High	200	200	100
Moderate	120	120	60
Low	50	50	50
Total Acres (Aspen)	370	370	210
Fuels Treatment Units (300s to 600s)			
High	170	100	100
Moderate	1,600	1,200	1,000
Low	130	100	100
Total Acres (Fuels)	1,900	1,400	1,200
Total Acres by Alternative	3,000	2,500	2,200

Note: All acreages are rounded off.

Units 103 to 106 may be hydrologically upgradient of the Whiskey Creek Landslide. Potential temporary roads accessing lodgepole pine treatment units would cross an estimated 4.3 miles of medium slope hazard areas and about 0.6 miles of high slope hazard areas. Approximately 0.3 miles of temporary roads would cross the prominent landslide known as the Whiskey Creek Landslide. All landing sites would be located in low and medium slope hazard areas.

Approximately 1.9 miles of cable corridors and tractor trails associated with lodgepole pine treatment units would lie in medium slope hazard areas, and 0.6 miles of these corridors and trails would lie in high slope hazard areas. About 0.9 miles of the potential temporary road in the Stone Creek area would lie within a medium slope hazard area.

About one half of the aspen treatment units, where all treatments would be accomplished without road construction, would be located in high slope hazard areas and about one fourth of these units would be located in landslide areas, as shown in and in **Table 3–20** and **Table 3–21**.

None of the fuels treatment units would be located in existing landslides. Only 10 percent of the fuels treatment units would be located in high slope hazard areas.

Soils

Effects on soils and their productivity resulting from the implementation of Alternative B would be relatively localized. Effects are expected to be relatively short-term (e.g. less than 3 years in the case of erosion). Design criteria would reduce short-term effects considerably and help eliminate most long-term soil effects. The acres of potential soil disturbance are shown in **Table 3–22** and the acres of disturbance that would be located in soil MUs sensitive to erosion or compaction are shown in **Table 3–23**.

Table 3–22 Potential Soil Disturbance by Alternative (Acres)

Treatment Activities	Alternative A	Alternative B	Alternative C	Alternative D
Erosion and Compaction				
Patch Cut/Remove Lodgepole Pine	X	12	12	12
Thin/Remove Lodgepole Pine	X	700	700	700
Cable Corridors and Tractor Trails	X	5	8	5
Landing Sites		3	3	3
Patch Cut Aspen and Pine/Leave	X	160	160	160
Erosion and Compaction	X	880	883	880
Displacement, Erosion, and Compaction				
Temporary Roads	X	27	26	27
Erosion Only				
Aspen Stand and Perimeter Treatments	X	210	210	50
Erosion and Thermal Damage				
Broadcast Burn	X	1,430	X	1,030
Pile and Burn/Broadcast Burn	X	230	X	60
Erosion and Thermal Damage	X	1,660	X	1,090
Erosion, Compaction, and Thermal Damage				
Mechanical Treatments/Pile and Burn	X	230	1,370	60

Notes: X = not included or applicable to an alternative

Table 3–23 Sensitive Soils Affected by Proposed Treatments by Alternative (Acres)

Treatment Units	Alternative A	Alternative B	Alternative C	Alternative D
Sensitive to Erosion				
Lodgepole Pine (100s)	0	420	419	420
Aspen (200s)	0	217	217	115
Fuels (300s to 600s)	0	1,312	818	762
Total Acres (Erosion)	0	1,949	1,454	1,297
Sensitive to Compaction				
Lodgepole Pine (100s)	0	71	71	71
Aspen (200s)	0	22	22	22
Fuels (300s to 600s)	0	105	105	105
Total Acres (Compaction)	0	198	198	198
Sensitive to Erosion and Compaction				
Lodgepole Pine (100s)	0	30	30	30
Aspen (200s)	0	118	118	60
Fuels (300s to 600s)	0	0	0	0
Total Acres (Erosion and Compaction)	0	148	148	90
Total Acres of Sensitive Soils by Alternative	0	2,295	1,800	1,585

As shown in **Figure 3–2** and **Table 3–23**, the majority of all treatments would be located in soils that are sensitive to erosion. The broadcast burn units without significant aspen components (Units 301, 302, 303, 309, and 310) are exceptions. These units would be located where 4 percent of the disturbance would occur on soils sensitive to erosion and 30 percent of the disturbance would occur on soils sensitive to compaction. Less than 15 percent of the lodgepole pine treatments would be sensitive to compaction. Approximately 37 percent of the proposed disturbance in aspen treatment units would occur in areas sensitive to compaction.

The proposed lodgepole pine treatments may adversely affect the productivity of soils in the treatment areas primarily due to accelerated water erosion caused by soil exposure to rain drop impact, reduced infiltration and permeability caused by compaction, modification of surface drainage patterns, and disruption of vegetation, surface litter, and soil organic matter. Soils would be displaced by the operation of logging equipment and by dragging logs along skid trails. Roads and landings would be constructed to implement the forest treatments. This would increase soil erosion because of the removal of vegetation, and the exposure of unconsolidated cut and fill slopes.

The proposed aspen treatment units would not involve road or trail construction or the use of mechanized equipment. Effects on soils from the enhancement of aspen fuelbreaks would be related to the disturbance of potentially unstable slopes.

The proposed fuels treatment units involve prescribed burning, which can have varying effects on soil resources depending on the length and severity of the burn. Pile burning and isolated pockets of detrimental burning associated with broadcast burns would remove the majority of the vegetation and soil organic matter and may increase water repellency of soils, thereby increasing runoff and erosion potential. Broadcast burns conducted so that organic matter on the forest floor is not fully consumed would result in minimal nutrient losses.

In the short-term, the reduction in soil nutrient status and coarse woody debris (CWD) would be expected to be higher in mechanically harvested/removed and thin/removed treatment areas than in hand cut/leave and broadcast burned areas due to the increased removal of trees, the high degree of soil disturbance, and removal of the soil profile associated with construction of roads, trails, and landings. Broadcast and pile burning would temporarily increase soil nitrogen and phosphorus status. If the soil temperatures of the prescribed burns remain low, in the long-term, the soil nutrient status and CWD levels should recover to current levels. However, in the short- and long-term, pile burning would likely remove soil organic matter and vegetation and induce water repellency, thereby reducing the overall nutrient status of the soils under the piles.

The average annual soil erosion rates for the proposed treatment units under each alternative were estimated according to the type of disturbance proposed using the Revised Universal Soil Loss Equation (RUSLE). The RUSLE (Renard, et al. 1997) is a technology for estimating potential soil loss from most native lands, lands undergoing construction, newly reclaimed lands, and reclaimed lands with established vegetation (Toy and Foster 1997). The approach is based on the Universal Soil Loss Equation (USLE) described by Wischmeier and Smith (1965, 1978). The RUSLE equation is described in *Guidelines for the Use of the Revised Universal Soil Loss Equation (RUSLE) Version 1.06* (Toy and Foster 1997) and *Design Hydrology and Sedimentology for Small Catchments* (Haan, et al. pages 249-284, 1994). It is important to note that the RUSLE approach is a relative predictor of soil loss from hillslopes, it does not predict erosion rates at the level of precision indicated by the calculated values, and it does not estimate sediment yield. Sediment yield would be less than soil loss because some of the eroded soils would not reach streams.

Soil loss rates for proposed treatment units were estimated in tons per acre per year for the year following treatment (Year 1) and 20 years following disturbance (Year 20). These calculations are documented in the *Project File*. These time periods were selected to best represent milestones in the life of the VVFH project. The estimated average annual erosion rates for Year 1 and Year 20 following disturbance are based on the estimates of soil loss. These erosion rates were calculated on a per-acre basis following disturbance in Year 1 in **Table 3–24** according to the treatment types and general site characteristics (e.g. slope and soil type). The estimated land disturbance by each treatment was multiplied by the predicted annual erosion rate on a per-acre basis to model the estimated soil loss for the proposed treatment units following disturbance in Year 1 **(Table 3-24)**. Soil loss per acre in Year 20 is shown in **Table 3-25** and soil loss for the proposed treatment units in Year 20 is shown in **Table 3-26**.

Table 3–24 Soil Loss from Proposed Treatment Units in Year 1 (Post-Treatment) by Alternative (Tons Per Acre Per Year)

Treatment Units	Alternative A[1]	Alternative B	Alternative C	Alternative D
Lodgepole Pine (100s)	0.02	1.6	1.7	1.6
Aspen (200s)	0.1	6.0	6.0	6.0
Fuels (300s to 600s)	0.03	4.1	2.6	3.2
Total Soil Loss by Alternative	0.04	3.7	2.9	2.8

[1] The estimated soil loss (erosion) under the No Action alternative (Alternative A) is based on the natural erosion rates for the same lands that would be affected under Alternative B

Table 3–25 Soil Loss from Proposed Treatment Units in Year 1 (Post-Treatment) by Alternative (Tons Per Year)

Treatment Units	Alternative A[1]	Alternative B	Alternative C	Alternative D
Lodgepole Pine (100s)	13	1,184	1,286	1,184
Aspen (200s)	41	2,202	2,202	1,250
Fuels (300s to 600s)	66	7,724	3,706	3,816
Total Soil Loss by Alternative	119	11,110	7,194	6,249

[1] The estimated soil loss (erosion) under the No Action alternative (Alternative A) is based on the natural erosion rates for the same lands that would be affected under Alternative B

Table 3–26 Soil Loss from Proposed Treatment Units in Year 20 (Post-Treatment) by Alternative (Tons Per Acre Per Year)

Treatment Units	Alternative A[1]	Alternative B	Alternative C	Alternative D
Lodgepole Pine (100s)	0.02	0.1	0.1	0.1
Aspen (200s)	0.1	1.5	1.5	1.5
Fuels (300s to 600s)	0.03	0.4	0.3	0.3
Total Soil Loss by Alternative	0.04	0.5	0.4	0.3

[1] The estimated soil loss (erosion) under the No Action alternative (Alternative A) is based on the same acres of land that would be affected under Alternative B

Table 3–27 Soil Loss from Proposed Treatment Units in Year 20 (Post-Treatment) by Alternative (Tons Per Year)

Treatment Units	Alternative A[1]	Alternative B	Alternative C	Alternative D
Lodgepole Pine (100s)	13	87	92	87
Aspen (200s)	41	541	541	307
Fuels (300s to 600s)	66	786	449	294
Total Soil Loss by Alternative	119	1,414	1,081	688

[1] The estimated soil loss (erosion) under the No Action alternative (Alternative A) is based on the same acres of land that would be affected under Alternative B

The soil loss estimates for the specific types of disturbances included in Alternative B are discussed below. Estimates range from 0.25 tons per acre per year for thinned lodgepole pine to 48 tons per acre per year for cable corridors and tractor trails during Year 1 following treatment. This range drops to 0.01 to 1.70 tons per acre per year during Year 20 following treatment. The estimated erosion from temporary roads prior to reclamation (represented by Year 1 estimates) ranges from 18 to 21 tons per acre per year. The estimated erosion from temporary roads following reclamation (represented by Year 20 estimates) ranges from 1.4 to 1.6 tons per acre per year. The decrease in estimated soil loss between Year 1 and Year 20 following treatment would be primarily due to increases in canopy cover and duff accumulation on the surface (plant litter) resulting from plant growth, reductions in slope length accomplished through reclamation activities, creation of natural slope breaks from vegetation growth, and fallen trees.

The area-weighted total soil loss for Alternative B for Year 1 following treatment would be approximately 11,000 tons per year. This weighted total drops to approximately 1,400 tons per year in Year 20 following treatment.

Soil erosion would exceed the soil loss tolerance thresholds of the dominant soils for all types of proposed disturbances in Year 1 following treatment, based on the estimated average annual erosion rates. Twenty years following treatment, soil loss tolerance thresholds would not be exceeded in any treatment areas. The soil-limiting factors provided in **Table 3–19** and the type of disturbance were used to develop the BMPs described in **Appendix D**. The BMPs would be implemented regardless of the overall sensitivity of the soil map units provided in **Table 3–19**.

The use of BMPs and other mitigation measures would reduce soil loss from the estimates described above, and minimize new sediment inputs to streams. Some erosion is expected from cuts, fills, and the road surface itself along the potential temporary roads. Interim reclamation of road cuts and fills would reduce erosion. Road reconstruction also may decrease sediment input to drainages in the long term as existing problem areas are improved. Where potential temporary roads cross or are near drainages, culverts or sediment barriers would be used at these road-drainage crossings.

Where applicable, cross drains on temporary roads can be emptied into vegetated filter strips to trap sediment and minimize connection to streams, lakes, and wetlands. Vegetated filter strips would need to be at least 100 feet wide to be effective. Where road drainage is located closer than 100 feet from streams, other mitigation can be used such as surfacing with 1 to 3 inch gravel, constructing sediment traps, or windrowing slash. If sediment traps are used, they will be keyed into the ground and cleaned out when 80 percent full.

Variations in soil loss rates among treatment units would be primarily due to intensity of disturbance, the erodibility of the predominant soils and slope, and slope length in the treatment units. Changes vary from complete soil exposure, to raindrop impact on temporary roads and landings, to limited soil exposure in aspen patch cuts. The intrinsic soil erodibility varies from the moderately erodible Ansel and Anvik Association soil map unit to the low erodibility of the Gateview-Handran-Eyre Families Complex map unit. Varying slopes and slope length in the treatment units would control the runoff characteristics of overland flow, affecting the displacement energy available for soil erosion.

The sum of detrimental soil impacts would be limited to no more than 15 percent of an activity area by properly managing, controlling, and mitigating soil erosion, compaction, and coarse woody debris (CWD). Excessive soil erosion would be minimized by maintaining ground cover during operations. On skid trails, landings, and temporary roads where this is not possible, the design standards and mitigation measures described in **Appendix D** and *FSH 2509.25 – Watershed Conservation Practices Handbook* would be followed to minimize the long-term effects of road and landing construction on soil erosion and compaction. Erosion from existing National Forest System Roads (NFSRs) used for project activities would probably decline compared with Alternative A during project implementation because of increased road maintenance during project activities. Temporary roads would be constructed with rolling grades instead of ditches and culverts, and water bars would be placed where appropriate to divert and dissipate flowing water. Temporary roads and landings would be recontoured where appropriate and reclaimed as soon as practicable following treatment, in accordance with design criteria. The effects of temporary roads and landings are considered long-term when compared with timber harvest, even when roads or skid trails are reclaimed.

As an integral part of treatment implementation, erosion would be controlled and CWD and soil nutrient levels would be maintained by leaving at least 12 tons CWD per acre following vegetation treatments, evenly distributing slash on treated areas, and placing a greater amount of slash on steep slopes within the

treated areas to slow runoff. Operations (especially skidding) would be avoided under wet and moist conditions. If unavoidable, compacted soils would be deep ripped when dry.

The implementation of the BMPs and design criteria described in **Appendix D** would not necessarily ensure that the erosion, compaction, and alteration in the amount, structure, and type of CWD and soil nutrients associated with Alternative B can be eliminated in the project area. However, the BMPs would reduce detrimental soil effects.

Alternative C

Other than those differences described below, the effects related to geology and soils would not be expected to vary from those described under Alternative B.

Geology

Under Alternative C, approximately 3.7 miles of cable corridors and tractor trails would lie in medium slope hazard areas, and 0.6 miles of these corridors and trails would lie in high slope hazard areas.

Under Alternative C, about one half of the aspen treatment units would be located in high slope hazard areas and about one fourth of these units would be located in landslide areas, as shown in **Figure 3–1** and **Table 3–20** and **Table 3–21**.

Lodgepole pine treatments under Alternative C would differ slightly from Alternatives B and D in that, under Alternative C, temporary roads would be constructed from Units 101 to 105 and from Units 102 to 104 instead of constructing a temporary road in the Stone Creek Trail area that would access Units 101 and 102. Regardless of where temporary roads are constructed for Units 101 and 102, all of the area affected by access to these units would be located in medium slope hazard areas.

Soils

Potential temporary roads that would access Unit 101 from Unit 105 and Unit 102 from Unit 104 would be constructed in soils that are sensitive to erosion but not susceptible to compaction. Although a temporary road in the Stone Creek trail area would create slightly more disturbance (3 acres) under Alternatives B and D than the temporary roads between Units 101 and 105 and between Units 102 and 104 under Alternative C (2 acres), additional disturbance for cable corridors would be required for Units 101 and 102 under Alternative C (3 acres) that would not be required under Alternatives B or D.

Although the majority of all treatments would be located in soils that are sensitive to erosion, the mechanical treatment units without significant aspen components (Units 301, 302, 303, 309, and 310) are exceptions. These units would be located where 4 percent of the disturbance would occur on soils sensitive to erosion and 30 percent of the disturbance would occur on soils sensitive to compaction. The proportion of soils sensitive to erosion in fuels treatment units under Alternative C would be similar to that of Alternative B; however, fewer acres of fuels treatments are proposed under Alternative C.

The estimated range for soil loss for lodgepole pine treatment units under Alternative C would be the same as that for Alternative B in Year 1 and in Year 20 following treatment, except for temporary roads. The estimated erosion from temporary roads prior to reclamation (represented by Year 1 estimates) ranges from 6 to 21 tons per acre per year. The estimated soil loss from temporary roads following reclamation (represented by Year 20 estimates) ranges from 0.5 to 1.6 tons per acre per year. The area-weighted total soil loss for Alternative C (all treatments) during Year 1 would be approximately 5,800 tons per year (**Table 3–25**). This weighted total would drop to approximately 900 tons per year in Year 20 following treatment (**Table 3–27**).

Comparatively, the estimated soil loss for Alternative C in Year 1 and Year 20 following treatment would be less than the losses predicted for Alternative B (**Table 3–24** through **Table 3–27**). In Year 1, annual erosion rates Alternative C would be 48 percent lower than Alternative B. In Year 20, annual erosion for Alternative C would be 35 percent lower than Alternative B. However, significantly more acres would be treated under Alternative B than under Alternative C.

Alternative D

Other than those differences described below, the effects related to geology and soils would not be expected to vary from those described under Alternative B.

Under Alternative D, about one half of the aspen treatment units would be located in high slope hazard areas and one third of these units would be located in landslide areas, as shown in **Figure 3–1** and **Table 3–20** and **Table 3–21**. Significantly fewer acres would be treated in aspen treatment units under Alternative D.

The estimated range for soil loss for lodgepole pine treatment units under Alternative D would be the same as that for Alternative B in Year 1 and in Year 20 following treatment. The area-weighted total soil loss for Alternative D (all treatments) during Year 1 would be approximately 6,300 tons per year (**Table 3–25**). This weighted total would drop to approximately 700 tons per year during Year 20 following treatment (**Table 3–27**).

Comparatively, the estimated soil loss for Alternative D in Year 1 and Year 20 following treatment would be less than the losses predicted for Alternative B (**Table 3–24** through **Table 3–27**). In Year 1, annual erosion for Alternative D would be 44 percent lower than Alternative B. In Year 20, annual erosion for Alternative D would be 49 percent lower than Alternative B. However, significantly more acres would be treated under Alternative B than under Alternative D.

Cumulative Effects by Alternative

Alternative A – No Action

Ongoing effects from soil-disturbing activities on adjacent lands and future soil-disturbing activities on private lands would contribute to cumulative impacts on soil resources in the project area.

While impacts from development on private lands are evident, and are likely to become more evident over time, the effects from most prior management activities on NF administered lands in the project area are not known, with the exception of roads, trails, and recreation facilities, including Vail and Beaver Creek ski resorts.

Roads, trails, ski trails, highway maintenance, and urban developments are contributing to relatively high levels of erosion. There are 79 miles of existing roads, 93 miles of trails, and two ski resorts located on NF-administered lands within the project area. This is the major reason that some of the watersheds in the project areas have a non-robust stream health classification.

In addition, the number of skier visits at these two resorts has increased 45 percent in the last 15 years and existing facilities will likely be upgraded in the foreseeable future. Newly constructed facilities at ski resorts and on private lands would continue to make the largest contributions to soil erosion in the project area for the foreseeable future. However, erosion rates should generally taper off after about 2 to 3 years for newly constructed facilities with the implementation of BMPs.

The demand for all types of new construction, including new housing, on private lands in the project area would continue to rise as it did from 1990 to 2000, contributing to additional soil disturbance. Most construction of housing units in Eagle County has occurred in the valley between Avon and Vail, outside municipal limits. There has been little space for the development of additional housing in Minturn.

Past and ongoing activities on NF administered lands are shown in **Table 3–40** in the Vegetation section of this chapter. Approximately 660 acres, or 1.5 percent of the forested portion of the project area, have been harvested over the past 22 years. The cumulative effects of these activities on soil resources would be a short-term soil loss followed by reclamation activities appropriate for the type of disturbance. This soil loss would be small compared with the contribution from ongoing and reasonably foreseeable construction on private lands, described above. Reasonably foreseeable Forest Service management activities in the project area would not be expected to contribute to cumulative conditions that would exceed soil disturbance or productivity standards in the Forest Plan.

Alternative B

The cumulative effects for Alternative B would vary only slightly from those described above for Alternative A – No Action, as described below.

Although most effects from the proposed treatments would be localized in the vicinity of the treatment units, ongoing effects from soil-disturbing activities on adjacent lands and future soil-disturbing activities on public and private lands would contribute to cumulative impacts on soil resources in the project area.

The VVFH project would add to past and ongoing activities on NF administered lands. The cumulative effects of these activities and the proposed project on soil resources would be a short-term soil loss followed by reclamation activities appropriate for the type of disturbance. This soil loss would be small compared with the contribution from ongoing and reasonably foreseeable construction on private lands, described above. Reasonably foreseeable Forest Service management activities in the project area would not be expected to contribute to cumulative conditions that would exceed soil disturbance or productivity standards in the Forest Plan. Sanitation and salvage in areas where mortality from mountain pine beetle (MPB) is high, or possible re-entry after 10 years into the lodgepole pine treatment units where ladder fuels need treatment or not enough basal area was removed under Alternative B to effectively modify future MPB risk would not be expected to result in cumulative conditions that would exceed the project-only effects. The site-specific layout of treatment units with stream buffers (WIZ) using BMPs would limit sedimentation in streams.

Alternative C

The cumulative effects for Alternative C would not be expected to vary from those described above for Alternative B.

Alternative D

The cumulative effects for Alternative D would not be expected to vary from those described above for Alternative B.

Forest Plan Consistency

All alternatives, when combined with management requirements, project design criteria, BMPs, and watershed conservation practices, will be consistent with the Forest Plan. The potential soil disturbance under any of the action alternatives, including any possible variation in acreage, would affect much less than 15 percent of any activity area.

Irreversible And Irretrievable Commitments

There are no irreversible commitments as a result of any of the alternatives. However, under the No Action alternative, there would be an increase in the buildup of natural fuels along with the associated potential for an intense wildland fire and soil loss accompanying the wildland fire that would become increasingly difficult to reverse.

Any noticeable soil impacts related to the action alternatives would be short-term, and should have no long-term consequences. Soil lost during project activities would represent an irretrievable commitment of resources.

3.3 THE BIOLOGICAL ENVIRONMENT

The biological environment is made up of vegetation and animals. When combined with the physical environment, they interact to form an ecosystem. Both plants and animals rely on the air, soil, and water to thrive. Plants and animals are also interdependent. Animals rely on plants for forage and habitat. Plants rely on animals and natural processes for succession and distribution. Natural processes such as fire, succession, and disease alter habitats over time. The biological environment is discussed in five subsections: biodiversity, vegetation, fire and fuels, wildlife, and fisheries.

3.3.1 Biodiversity

Resource Description

Biological diversity, or biodiversity, is the full variety of life in an area, including the ecosystems, plant and animal communities, species, and genes, and the processes through which individual organisms interact with one another and their environments (USFS 1992). Characteristics of biodiversity include ecosystem composition, structure, and function. These components describe the interactions of living organisms with each other and the non-living environment at all spatial (geographic) and temporal (time) scales. Composition refers to naming of the elements, such as a listing of all the species that occur in the area. Structure is the physical arrangement or distribution of the species in the area. Function includes the evolutionary and ecological processes, including nutrient cycling, disturbances, and gene flow (USFS 1997).

Only those organisms adapted to exist within the normal environmental fluctuation can successfully remain in an area. Biodiversity fluctuates over time and space, and scale is an important consideration. From genes and species to ecosystems and landscapes, there is an inherent capability for each level to cope with change (USFS 1997).

Another area of biodiversity change is in the species mix of animals and plants. The introduction of exotic species changes biodiversity. Some exotics have been intentionally introduced while others escaped from unintended introductions. Additionally, some species have been extirpated (removed) from the Forest, such as the wolf, grizzly bear, and mountain bison. Biodiversity changes with disturbance, long-term climate changes, immigration and emigration of species, and human influences. Biodiversity has fluctuated in the past and it will continue to change in the future. It does not and cannot remain static (USFS 1997). Project activities could affect biodiversity in the Forest by causing a change in the species mix of animals and plants.

Indicators

- Effects on species mix of animals and plants
- Effects on retention of snags and woody debris and snag recruitment
- Effects on late successional and old growth components
- Effects on ecosystem health

Forest Plan Direction

Overall management direction for the WRNF includes the regional goal of providing for a variety of life through management of biologically diverse ecosystems (Forest Plan, page 1-1). Forest-wide objectives for ecosystem health include maintaining or improving ecosystem health and ecosystem conservation; providing ecological conditions to sustain viable populations of native and desired nonnative species and achieve management objectives for special status species; and increasing the amount of forest and rangelands restored to or maintained in a healthy condition with reduced potential for damage from fires, insects, disease, and invasive species (Forest Plan, pages 1-3 to 1-9).

Forest-wide standards for biodiversity (Forest Plan, pages 2-8 and 2-9) include requirements for use of native plant species for revegetation, requirements for recruitment of snags and retention of snags and woody debris during management activities, and requirements for managing late-successional and oldgrowth components. A minimum of 10 percent of the lodgepole pine within each late-successional assessment area (LSAA) must be maintained as late successional to ensure that late successional structural stages (4B, 4C, and 5) are well-distributed across the WRNF (Forest Plan, page FF-2).

Forest-wide guidelines for biodiversity (Forest Plan, page 2-9) include emphasizing the ecological importance of the aspen vegetative type through enhancement or regeneration, and establishing priorities for conserving late-successional components by considering specific factors. Forest-wide guidelines for disturbance processes (Forest Plan, page 2-29) provide guidance for insect or disease outbreaks.

Guidance for MA 5.41 (Forest Plan, page 3-58) includes a biodiversity standard that requires vegetation composition and structure to be managed to meet the needs of deer, elk, and other species on their winter ranges within the constraints of conserving biological diversity and maintaining and enhancing sensitive habitats.

Desired Condition

The desired condition for designated wilderness and other minimal-use MAs (MA 1.12 and 1.31) includes allowing ecological processes such as fire, insects, and disease to operate relatively free from human influence. Natural processes are the primary factors affecting landscape patterns in these areas; however, because of past management activities such as fire suppression and other human uses, some localized areas have ecological conditions that are outside their historic range. Management tools, including prescribed and wildland fire (to restore ecological values), can be used in accordance with MA direction to meet ecological objectives within HRV conditions (Forest Plan, page 3-3).

In MA 5.4 and MA 5.43, a combination of natural processes and active management treatments affect ecological conditions. Timber harvest activities in MA 5.4 and MA 5.43 will be designed to result in more early-successional aspen and lodgepole pine, providing a diversity of age class that will be closer to historical conditions (Forest Plan, page 3-49). Management activities will emphasize natural landscape objectives such as patch size, rotation age, and patterns as described in the HRV.

Vegetation management is designed to simulate natural disturbances, and will provide adequate late-successional structure components in forested stands, and maintain fire-dependent ecosystems over the long-term. Stabilization or restoration concepts are applied to areas where natural disturbance or past management has reduced desired resource conditions. Under endemic conditions, insects and disease are generally accepted unless they threaten ecosystems that are providing important habitat components (Forest Plan, page 3-55). Under the current epidemic conditions, the desired condition in MA 5.4 would incorporate additional factors described in the Forest-wide guidelines for disturbance processes, which are applicable to ongoing and future insect or disease outbreaks (Forest Plan, page 2-29).

In MA 5.41 and MA 5.42, natural ecological disturbances are the dominant agent of change. There will be some vegetation management, and these activities will be designed to mimic natural disturbance processes. The resulting ecological conditions will improve deer and elk winter range and bighorn sheep habitat. Management activities will not dominate the landscape, however (Forest Plan, pages 3-49 and 3-50).

Current forest health conditions in MA 7.1 are primarily a result of land management activities, not natural processes. Vegetation management will be designed to reduce fuel loading and meet visual objectives. Historic conditions may not be attainable in these areas because of urbanization factors such as access, fire potential, and recreation use (Forest Plan, page 3-73).

Ecological conditions and processes, including historic conditions, are likely to be permanently altered by human activities in MA 8.25 and MA 8.32. Ecological values are protected where they affect the health and welfare of human occupancy (Forest Plan, page 3-77).

Temporal Scope

This analysis considers effects on biodiversity over a period of 5 to 20 years. Within 5 to 20 years, changed conditions, such as localized outbreaks of MPB, vegetation growth, fuel loading, or wildland fires, likely would need evaluation.

Geographic Scope

Biodiversity will be most directly affected in the proposed treatment units and along access routes that will be used for project activities. The project area may be indirectly and cumulatively affected. Late-successional assessment areas within the project area will be affected by lodgepole pine treatments.

Habitat components for many different species could be affected, and some habitats extend beyond the project area boundary. Some wildlife species are managed within unique management units. The Canada lynx is managed within lynx analysis units (LAUs). There are four LAUs within the project area including Eagle Valley, Holy Cross, Camp Hale, and Brush Creek. Potential effects to the lynx, its habitats, and prey will be assessed within these LAUs. The Colorado Division of Wildlife (CDOW) manages elk and deer populations within data analysis units (DAU). DAUs are determined by an arbitrary boundary based on studies that show limited interchange between population segments of a species. Within the project area, there are portions of two elk DAUs: DAU 12 and DAU 16. The project area is located within a portion of deer DAU 8. Additionally, the Forest has designated MAs 5.41 (Deer and Elk Winter Range), 5.42 (Bighorn Sheep Habitat), and 5.43 (Elk Habitat) to manage habitats that support deer, elk, and bighorn sheep. Potential effects to these MAs within the project area will be assessed.

Affected Environment

This section describes the species mix of plants and animals in terms of the historic range of variability, late-successional and old-growth components, species associations, and ecosystem health.

Historic Range of Variability

The following discussion is condensed from the *Final Environmental Impact Statement, Volume 3 for the Land and Resource Management Plan, 2002 Revision, Appendix D*. **Appendix D** covers the entire Forest. The discussion below includes some of the key points that pertain to species and activities in the project area.

A large portion of what is now the WRNF was heavily impacted by early European settlement between approximately 1870 and 1910. Much of the current forest vegetation is directly related to the major disturbance events associated with this period and the accompanying demand for resources. Mining in the 1870s to 1890s produced major changes in the forested landscapes through the extraction of timber and use of fire. Gold, silver, and coal mining (1870 to 1890s), farming and ranching (1890 to present), federally subsidized access built by the Civilian Conservation Corps (CCC) (1930 to 1940s), and increased forest management technology (1980 to present) have all resulted in vegetation change. Wildland fires have been aggressively suppressed since the early 1900s, although this effort has likely been most successful only after about 1940 when modern vehicles and equipment became available and extensive road networks made remote locations accessible (Graham et al. 2004).

The fires and other disturbances that occurred during this period regenerated approximately 50 to 60 percent of the current aspen and lodgepole pine forest-wide. The current, high percentage of 90- to 150-year-old, even-aged stands of seral lodgepole pine and aspen are the result of this disturbance period. Only limited disturbances, either natural or human-caused, have occurred in the past 80 years. Some of the current spruce/fir was established during European settlement, but the majority of this cover type predates this period.

Due to a lack of recent disturbances, the forest is trending towards increased maturity and canopy density for most cover types. MPB activity has created localized gaps in the lodgepole pine canopy, but undesireable fuel loading has resulted. Early structural stages of forest ecosystems (grass/forb, seedling/shrub, sapling) occur in limited quantities and are not well-dispersed across the landscape. Recent forest management has resulted in highly contrasting patches and a decrease in overall forest maturity within the most intensively managed areas. 660 acres, or 1.5 percent of the forested portion of the project area west of Minturn in MAs 5.4 and 5.43 and within the ski areas, that have been harvested over the past 22 years.

Salvage of standing dead spruce and lodgepole pine dominated silvicultural practices in the 1940s through 1970s. Clearcutting, resulting in complete stand regeneration, was used for most cover types beginning in the mid 1980s, generally for economic reasons. Practices then shifted toward insect and disease control strategies. Over the past 7 years, sanitation and salvage, with a limited amount of thinning, have occurred during the current beetle outbreak.

Shrublands in the project area, primarily mountain big sagebrush communities, are in declining health. Pinyon pine and juniper have increased their distributions throughout much of their range by moving into shrublands. Fire suppression and continued livestock grazing in these cover types may have altered the composition and overall coverage of stands capable of producing a grassy understory in which low-intensity fires occasionally occurred. These low-intensity fires that favored the persistence of shrublands often limited reproduction and spread of pinyon pine and juniper.

Quaking Aspen

About 19 percent of the WRNF (or approximately 425,000 acres) contains aspen communities. About 23 percent of the project area is forested by aspen. In the portions of the Forest not significantly impacted by the major disturbance events associated with European settlement, widespread fire suppression over the last 60 years has allowed many aspen stands to proceed through natural succession into spruce and fir. This is a normal successional pathway for these cover types. Stands of pure aspen can be difficult to burn under typical climatic conditions, and fire return intervals of 100 to 300 years have been documented. It is likely that fire suppression over the past 60 years has affected individual aspen stands that might have burned and regenerated during dry seasons. However, due to the long fire return interval possible for this type, it is doubtful that the relatively short period of intensive fire suppression would have reduced disturbances enough to move these aspen landscapes outside of the HRV for composition.

Approximately 50 to 60 percent of the seral aspen stands for which age data are available (Rocky Mountain Resource Information System database) regenerated between the years 1870 and 1910. This is a higher percentage of one age class than would be expected based on the natural disturbance regimes for this species. Conifer invasion that is currently observed is largely a result of the natural succession of stands disturbed at the turn of the century during early settlement. If the perpetuation of aspen is desired, either to serve as forested fuelbreaks or to diversify canopy cover, management is necessary in the absence of disturbance.

Lodgepole Pine

Approximately 50 to 60 percent of the lodgepole pine that exists on the Forest was regenerated between 1850 and 1910. These lodgepole pine stands occur on approximately 22 percent of the project area. Detailed information on the pre-settlement pattern of lodgepole pine is not available. From 1870 to 1910, European settlers undertook a period of rapid resource development. This settlement activity resulted in large fires across much of the Forest. The stands of lodgepole pine that regenerated during this period have been relatively immature during the 20th century and have not been subjected to large-scale disturbances.

These large landscapes of single-species, relatively even-aged stands are nearing the stage in development when increases in disturbance can be expected, especially from MPB outbreaks. Increasing MPB activity in the Vail area has raised local concern over forest health. As disturbances occur, areas of forest will shift to a more early successional composition and structure. Overall forest structure will likely be a more balanced and dispersed distribution unless a large stand-replacing disturbance produces areas of early successional, even-aged stands..

Fire suppression during the past 60 years has allowed natural succession to proceed from lodgepole pine to spruce and fir in those areas not significantly impacted by the major disturbance events associated with European settlement. In those areas, fire suppression may have prevented some stand-level regeneration, but because of the long fire return interval in these forest types, it is doubtful that there have been significant changes to the historical range of variability of structural stage distribution conditions over the past 80 years.

Late Successional and Old Growth Components

The WRNF has been divided into 13 LSAAs (Forest Plan, page FF-1). Three LSAAs (8, 9, and 13) are represented within the project area. The objective of the LSSAs is to direct management of late-successional or old-growth forests on the similar scale of natural, landscape-level disturbances (Forest Plan, page 2-9 and Appendix FF). A minimum of 10 percent of the lodgepole pine within each LSAA

must be maintained as late-successional to ensure that structural stages 4B, 4C, and 5 are well-distributed across the WRNF. Habitat structural stages are described in more detail later in the Biological Environment Section under Vegetation.

A total of 685 acres of late-successional lodgepole pine are included in proposed treatment units. Neither of the two other late successional cover types for the WRNF exist in proposed treatment units. **Table 3–28** shows the acres of late-successional lodgepole pine that would be affected by the project. The status of late-successional acreage in the portion of LSAAs outside of the project area is not known.

Table 3–28 Lodgepole Pine Distribution in LSAAs

LSAA	Total Acres in LSAA	LSAA Acres in Project Area	Acres of Late-Successional Lodgepole Pine in Treatment Units (percentage of LSAA affected)
8	134,384	7,852	211 (<1 %)
9	121,043	40,414	13 (<1 %)
13	250,576	24,139	461 (<1 %)
Total	506,003	72,405[1]	685[2]

[1] All lands within the project area boundary, regardless of surface ownership.
[2] Eleven acres of lodgepole pine are in HSS 3C, and do not contribute to LSAA acreage.

Species Associations and Ecosystem Health

Many biological communities exist within the project area, supporting a variety of plant and animal species. These species rely on each other for optimal growth and success. Healthy plant communities reflect healthy animal communities and vice versa. Fire suppression has altered the natural state of some of these communities. Several species pairings (associations and interactions) indicative of ecosystem health include lodgepole pine and MPB, aspen and elk, and Canada lynx and snowshoe hare.

Fire suppression has caused major changes in the spatial pattern and ecological process of shrub and grassland ecosystems. If continued, fire suppression will predispose some forested ecosystems to dangerous fire behavior. This has resulted in the loss of structural stage variability. Early successional stages are less frequent, while mature, dense forests are more common. Overall, forested areas are trending toward late successional stages – older age classes and denser canopy closure. Although MPB is creating breaks in the forest canopy, the largest trees are often the first to succumb to attack. The loss of the largest trees, coupled with the increase in fuels accompanying MPB infestation, greatly outweigh the perceived benefit of decreasing canopy closure through MPB activity. These factors aid in the proliferation of MPB and increase fire hazard.

The forested portion of the project area is a lodgepole pine and aspen dominated ecosystem. The MPB population in the project area is currently at epidemic levels. The current structure and density of lodgepole pine stands is sustaining a MPB population much larger than would be present historically. Large, contiguous areas of lodgepole pine are at risk from these elevated MPB populations. Under natural disturbance regimes, MPB kills many of the largest trees, and then declines until beetle populations, climatic conditions, and host tree composition are able to sustain another outbreak cycle. The cycle of outbreak and die-back can occur every 20 to 40 years until the lodgepole pine food source for the beetle is exhausted, lodgepole pine is replaced by another species, or a fire, fueled by the deadfall generated by the beetle, consumes the stand. In most cases the fire event is followed by the regeneration of another lodgepole-pine-dominated landscape and the cycle of beetle outbreaks continues.

Aspen is considered a disturbance species perpetuated by fire, disease, or other occurrences. Fire suppression has caused the successional replacement of aspen by conifers, which is a natural process in the absence of disturbance. When aspen-dominated landscapes are not functioning properly or are lost, the diverse values provided by aspen are compromised or lost. The decline of aspen in Colorado is estimated to be 49 percent. Healthy stands of aspen with good regeneration provide early successional stages that serve as browse for elk and deer.

Snowshoe hare also rely on early successional stages – vegetation that is near the ground, such as low-hanging conifer branches or saplings, for food and shelter. Canada lynx feed primarily on snowshoe hare. Snowshoe hare habitat and populations in the project area are currently being studied as part of the ongoing Broad Scale Lynx Habitat Assessment.

Wildlife species dependent on early successional stages, such as elk, snowshoe hare, and deer, experienced high habitat capabilities during the late 1800s and early 1900s (USFS 1997). Although current population levels of elk and deer are similar to pre-settlement population levels, and water developments for livestock have increased their usable habitat, habitat capability for elk and deer is not improving as the age of forested stands increases.

Less dense lodgepole pine and increased vigor in aspen stands could affect biodiversity differently. Lodgepole pine thinning and fuels reduction could result in a decrease in potential Canada lynx denning habitat and decreased risk of MPB outbreak. Increased aspen could result in more potential elk foraging habitat. Increasing acreage of earlier successional stages could result in increased snowshoe hare habitat.

Environmental Effects

Direct and Indirect Effects by Alternative

Alternative A – No Action

Under Alternative A, the No Action alternative, biodiversity would change over time from its existing condition, as natural processes and disturbances, human activities, ongoing management activities, and fire suppression activities dictate plant and animal species composition and presence or absence in the project area. Natural ecological disturbances would continue to occur and would be the dominant agent of change affecting biodiversity in the project area. Insects and disease would operate relatively free from human influence. Species presence may increase or decrease in the project area in response to natural habitat changes (landslides, wildland fire, succession, drought), disease, human influence, or fluctuations in population size. Portions of the project area would become increasingly susceptible to large stand-replacing fires.

Ecological conditions and processes would continue to be altered by human activities along the I-70 corridor, Vail and Beaver Creek ski resorts, and along the wildland urban interface. Human influence over wildland fires would continue. Human occupancy of the wildland urban interface would continue to increase, with corresponding increases in developed areas requiring protection, human-caused fires, and fire suppression efforts.

Increased maturity and canopy closure are characteristic of late successional structural stages and would become more prevalent in the project area over time. Landscapes outside the HRV and those shifting outside the HRV would continue along these trends unless restored by a natural disturbance, such as a wildland fire. Natural succession of stands, including conifer invasion of aspen stands, would continue unless aspen are regenerated through management activities. The proportion of late successional area in LSAAs within the project area would not change without a landscape-level event such as wildland fire, blow down, or insect outbreak.

MPB would continue to impact currently infested lodgepole pine stands, and likely would spread to uninfested stands under Alternative A. Heavily infested stands would experience 50 to 70 percent mortality of the largest lodgepole pine. Following such an intense outbreak, it is likely that few live lodgepole pines more than 8 inches DBH would remain. Snags caused by MPB infestation would remain and deteriorate naturally. Continued MPB activity would add to the snag density over time. Amounts of downed woody debris would increase as snags and dead branches fall.

There would be no reduction of fuels or establishment of fuelbreaks. Existing wildland fire hazards would increase as fuel levels increase over time, as would potential wildland fire intensity. Should a wildland fire occur under this alternative, larger volumes of accumulated fuels could be consumed by fire and result in larger or more severe fires that could have a greater effect on the biodiversity of the project area.

Alternative B

Alternative B would affect a wide range of species and habitats. Portions of communities would be removed through thinning or burning; however, Alternative B would not result in the complete conversion of any community type. Alternative B would temporarily displace wildlife sensitive to disturbance, but their return following project activities would be expected. The effects of wildland fire under Alternative B would be similar to Alternative A, but reduced fuel loads and enhanced fuelbreaks under Alternative B may lessen the severity or extent (acres) of the burn, reducing the effects on biodiversity.

Alternative B would affect biodiversity primarily by disrupting habitats. For a short time, thinning, mechanical treatment, and burning operations would displace those species not adapted to human presence. Displaced wildlife would be expected to return to the affected area following treatments or relocate to an adjacent habitat in the project area. No treatments would remove a significant portion of any single plant species or community. Where sanitation and salvage is applied to heavily damaged lodgepole pine stands, up to 70 percent of the basal area may be removed. Removal of the largest trees mimics the effects of the MPB outbreak, but removes infested and dead trees from the stand rather than leaving them onsite in an unmitigated outbreak. In areas selected for sanitation and salvage, this treatment will preserve forest health and biodiversity as much as possible given the current impacts of MPB. Following all harvesting, sufficient vegetation would remain post-treatment to ensure perpetuation of the current species composition. Where little or no seed-bearing trees remain, design criteria (**Appendix D**) would be applied to ensure regeneration of lodgepole pine.

Alternative B would salvage hard and soft snags greater than 9 inches DBH and less than 15 years old from lodgepole pine and aspen treatment units. If healthy and uninfested, the largest live green trees would be retained for future snag recruitment to maintain habitat diversity. Endemic MPB would also create snags as infestations progress. Excessive ground fuels (downed woody debris) would be removed from lodgepole pine stands to reduce potential fire intensity. Aspen enhancement in the Vail Intermountain area would leave all cut trees in the stands because maintaining the unroaded character of the Vail Intermountain area would not allow for the removal of the cut trees. This increase in downed woody debris would increase the fuel load. These added fuels would be bucked into shorter lengths, limbed, and placed in contact with the ground to minimize the effects of their addition to the current fuel load.

Thinning treatments would affect the current distribution of late successional habitat in approximately 700 acres of lodgepole pine and approximately 160 acres of aspen patches within the lodgepole pine. Aspen, though a component of late successional habitat, is not included as a contributor in any LSAA in Forest Plan guidance. Where 30 to 50 percent of the basal area is thinned, the amount of late successional area within each LSAA in the project area would not change. Where sanitation and salvage is necessary,

model results indicate that those areas would be converted to stand structures not designated as late successional. With different or no treatments, these stands would likely be similarly converted to non-late-successional structures as MPB continues to kill the largest, dominant lodgepole pine.

Patch cuts, sanitation, and salvage would result in more early successional aspen and lodgepole pine. Proposed broadcast burning in shrublands would diversify age classes, shifting treated areas toward historical conditions. Vegetation management would simulate natural disturbances, provide adequate late successional structure components in forested stands, and maintain fire-dependent ecosystems over the long-term.

Alternative B would modify MPB risk in treated areas. Infested and deteriorating trees would be removed, limiting MPB spread within a stand, reducing the impacts of future infestations, and making water and sunlight available to remaining vegetation. Treatments designed to reduce wildland fire hazards in shrublands would remove accumulated fuels by mechanical treatments or prescribed burning. In contrast to wildland fire, elimination of fuels in this controlled manner would allow for the conservation of desired ecosystem components and avoidance of sensitive areas.

The enhancement of aspen stands in the Vail Intermountain area as natural fuelbreaks under Alternative B would renew these aspen stands and limit the invasion of conifers. The restoration of aspen stands would contribute to the biodiversity of the project area by retaining aspen stands that are characteristic of the HRV for the area.

Approximately 140 acres of sagebrush- and rabbitbrush-dominated communities would be treated for fuel reduction under Alternative B. This accounts for 8 percent of this community type in the project area. This treatment would remove successional pressure from western juniper and allow sagebrush to maintain dominance.

Alternative C

The effects of Alternative C would be the same as Alternative B except that Alternative C would affect fewer acres north of the I-70 corridor by eliminating approximately 800 acres of fuels reduction in the Eagles Nest Wilderness. The use of mechanical fuels reduction rather than broadcast burning under Alternative C would avoid potential adverse effects on wildlife species unable to escape broadcast burns, as well as those sensitive to heat or smoke. This method of fuel reduction would require a longer human presence in the treatment units than would broadcast burning.

Alternative D

Under Alternative D, enhancement of aspen stands in the project area would be greatly reduced when compared with Alternative B. As a result, natural succession of aspen stands by invasion of conifers would be more prevalent in the Vail Intermountain area.

Cumulative Effects by Alternative

Alternative A

Biodiversity would change over time from its existing condition. Species presence may increase or decrease in the project area in response to natural habitat changes (continued MPB outbreaks, landslides, wildland fire, succession, drought), disease, human influence, or fluctuations in population size. Ecological conditions and processes would continue to be altered by human activities along the I-70 corridor, Vail and Beaver Creek ski resorts, and along the wildland urban interface. Human influence over wildland fires would continue.

Effects from ongoing activities on public and private lands and future activities on private lands within the project area would contribute to cumulative impacts on biodiversity in the project area, however, natural ecological disturbances, primarily active MPB outbreaks, would be the dominant agent of change affecting biodiversity in the project area. Landscapes outside the HRV and those shifting outside the HRV would continue along these trends unless restored by a natural disturbance, such as a wildland fire.

In areas escaping MPB infestation, increased maturity and canopy closure would become more prevalent in the project area over time. Insects and disease would operate relatively free from human influence; MPB would continue to impact lodgepole pine stands. Natural succession of stands, including conifer invasion of aspen stands and juniper encroachment in shrublands, would continue. Existing wildland fire hazards would increase as fuel levels increase over time. Portions of the project area would become increasingly susceptible to large stand-replacing fires.

Table 3–40 in the Vegetation section of this chapter identifies activities since 1982 in the project area. The cumulative effects of these activities on biodiversity should be very small and short-lived, based on the acres involved and the effective and comprehensive implementation of BMPs.

Alternative B

The cumulative effects for Alternative B would vary only slightly from those described above for Alternative A – No Action. These variations are described below.

The VVFH project would add to past and ongoing activities on NF administered lands. Most effects from the proposed treatments would be localized in the vicinity of the treatment units due to the implementation of design criteria and BMPs. The VVFH project would add to past and ongoing activities designed to improve biodiversity and ecosystem health. The cumulative effects of these activities and the proposed project would be the maintenance of diverse cover types, habitats, and varied forest structure. In the treated stands, reducing the potential for future MPB outbreaks and reducing wildland fire hazards would help ensure the presence of diverse habitats and varied ecosystem components. Sanitation and salvage in areas where mortality from MPB is high, or possible re-entry into the lodgepole pine treatment units where ladder fuels need treatment or not enough basal area was removed to effectively modify MPB activity would not be expected to result in cumulative conditions that would exceed the project-only effects for the lodgepole pine treatments.

Alternative C

The cumulative effects for Alternative C would vary only slightly from those described above for Alternative B – Proposed Action. These variations are described below.

Under Alternative C, broadcast burning would not occur. While mechanical treatments under Alternative C would be effective in reducing fuel loads that contribute to wildland fire hazards, Alternative C would not add diversity to the successional stages present in shrublands north of the I-70 corridor, as overmature and decadent shrublands would not be replaced by young vegetation after broadcast burning.

Alternative D

The cumulative effects for Alternative D would vary only slightly from those described above for Alternative B – Proposed Action. These variations are described below.

Under Alternative D, aspen enhancements would occur on 160 fewer acres in the Vail Intermountain area than under Alternative B. The limited acreage treated outside the Game Creek inventoried roadless area might not have any noticeable effect on the vigor or size of aspen stands in the Vail Intermountain area, and may not retard the encroachment of conifers.

Forest Plan Consistency

All action alternatives will meet the direction detailed in the Forest Plan and are consistent with MA standards and guidelines highlighted at the beginning of this chapter as they pertain to biodiversity.

Irreversible and Irretrievable Commitments

No irreversible or irretrievable commitments of biodiversity would result from the VVFH project. No species, resources, or habitats would be permanently removed or altered as a result of implementing the project.

3.3.2 Vegetation

Resource Description

Vegetation resources that can be affected by management activities include forested vegetation, special-status species, wetland and riparian areas, range resources, and noxious weeds and invasive species. Susceptibility of lodgepole pine to MPB outbreaks and high-intensity crown fires could be changed by vegetation treatments. Special-status species could be affected by the destruction of habitat or harm to individuals. Rangeland resources could be affected by changes in vegetation, increased erosion, introduction of invasive species, or soil compaction. Wetland and riparian areas could be lost or affected by erosion or soil compaction. Noxious weeds and invasive species could increase in areas where they already exist or be introduced into new areas from surface-disturbing activities or project traffic.

Indicators

- Change in forested cover types
- Effects on habitat structural stages (HSSs)
- Aspen HSS distribution, 20-year projection
- Aspen enhancement
- Mountain pine beetle (MPB) risk and 20-year projections
- Effects on threatened and endangered species of plants
- Effects on Forest Service sensitive species of plants
- Effects on plant species of viability concern
- Effects on wetlands and riparian areas
- Effects on rangeland resources
- Effects on areas susceptible to noxious weed infestation
- Available corridors for seed transport along roads and trails
- Proximity of treatment areas to known or inventoried populations of noxious weeds, in acres

Forest Plan Direction

The overall direction for managing the vegetation resources of the WRNF includes the national strategic goals to maintain fuel profiles that contribute to the most cost-efficient fire protection and use program; to manage timber and other forest resources for protection, enhancement, and sustained yield of those resources; to use an integrated weed management approach to control and contain the spread of weeds; to integrate management of range vegetation with other resource programs; to protect riparian areas while implementing management activities; and to manage timber stands at high risk of spreading disease or insect epidemics to prevent volume loss (Forest Plan, pages AA-5, AA-9, AA-10, AA-12, and AA-13). Overall management direction for the WRNF also includes the regional goal of providing for multiple uses and sustainability of national forests and grasslands in an environmentally acceptable manner (Forest Plan, page 1-1).

Forest-wide standards for soils require management of land treatments to limit the sum of detrimental soil impacts to no more than 15 percent of an activity area (Forest Plan, page 2-5). Vegetation and fuels management treatments must be designed to retain specified levels of coarse woody debris (CWD) per acre (10 tons per acre total down CWD for lodgepole pine and 3 tons per acre total down CWD for aspen (Forest plan, page 2-5). Forest-wide standards for water and riparian resources (Forest Plan, pages, 2-6 and 2-7) allow only activities that maintain or improve long-term stream health or riparian ecosystem condition to occur in the WIZ; require long-term ground cover, soil structure, water budgets, and flow patterns of wetlands to be maintained to sustain the ecological function of wetlands, per 404 regulation; and require that vehicles and equipment be kept out of streams, lakes, and wetlands, except to cross at designated points. Forest-wide standards for biodiversity (Forest Plan, pages 2-8 and 2-9), specify average minimums of snags and downed logs for retention and replacement trees for future snags, and require the long-term management of a minimum of 10 percent of the late-successional lodgepole pine in each LSAA for late-successional characteristics. Forest-wide guidelines for biodiversity emphasize maintaining or enhancing aspen when compared with the reference landscape, establish priorities for aspen regeneration, and provide guidance on conserving potential or existing late successional stands. (Forest Plan, page 2-9). Forest-wide standards and guidelines for silviculture (Forest Plan, pages 2-11 through 2-16) allow the use of even-aged and uneven-aged management systems with specified design criteria in a manner that ensures natural regeneration, provided that the maximum size of openings created by even-aged management will be 40 acres, unless specific exceptions apply. Forest-wide guidelines for disturbance processes (Forest Plan, page 2-29) provide guidance for insect or disease outbreaks. Forest-wide standards for noxious weeds (Forest Plan, page 2-30) require the determination of risk of noxious weed introduction or spread for proposed projects and implementation of appropriate prevention and mitigation measures.

Applicable standards for vegetation management in MA 5.4 include the determination that these areas are part of the suitable timber land base and a full range of vegetation treatments may be applied. Applicable standards for vegetation management in MA 5.41 include the determination that these areas are not part of the suitable timber land base and vegetation management will be designed to maintain or improve deer and elk habitat objectives. Applicable standards for vegetation management in MA 5.42 include the determination that these areas are not part of the suitable timber land base and vegetation management will be designed to maintain or improve bighorn sheep habitat. Applicable standards for vegetation management in MA 5.43 include the determination that these areas are part of the suitable timber land base and vegetation management will be designed to maintain or improve elk habitat. Applicable standards for vegetation management in MA 7.1 include the determination that these areas are not part of the suitable timber land base and vegetation management practices will be used to meet resource management objectives other than wood production.

Guidelines for MA 7.1 include direction to minimize the potential for insect and disease outbreaks through vegetation treatments, maintaining stands at a moderate or lower risk. Applicable standards for vegetation management in MA 8.25 include the determination that these areas are not part of the suitable timber land base, and vegetation management practices will be used to maintain and improve ski area objectives. Applicable guidelines in MA 8.25 include managing stands and islands of trees to provide a variety of species and size classes and perpetuate forest cover; and designing vegetation management operations to complement snow management objectives and scenery and recreational values.

Desired Condition

The desired condition for vegetation resources includes a number of components. Protecting special-status species and maintaining, improving, or increasing suitable habitat for these species is emphasized. Management activities should increase the amount of forest and rangelands restored to a healthy condition and reduce the risk associated with future pest outbreaks. However, the desired condition for designated wilderness and other minimal use management areas includes allowing ecological processes such as fire, insects, and disease to operate relatively free from the influence of humans. Protecting, maintaining, and improving the health of wetlands and riparian areas is required for future stream health. Management activities should emphasize eradicating populations of noxious weeds, and preventing future colonization of these species.

Areas within the suitable timber land base provide for a variety of forest and non-forest plant communities and successional stages, over the long term, through a combination of human manipulation and natural processes. Management activities are influenced by biological processes found in the area and strive to replicate local natural vegetation patterns and patch size (HRV).

Insects and disease are generally accepted in MA 5.4 unless they threaten ecosystems that are providing important habitat components (Forest Plan, page 3-55). However, this desired condition for insects and disease in MA 5.4 applies to endemic conditions. Under the current epidemic conditions, the desired condition in MA 5.4 would incorporate the following factors described in the Forest-wide guidelines for disturbance processes, which are applicable to ongoing and future insect or disease outbreaks (Forest Plan, page 2-29). Management activities meet MA objectives and are planned with consideration for potential insect or disease outbreaks. During outbreaks, vegetation in high-use recreation areas is managed to provide for public safety and to improve forest health, as needed, to maintain or improve the desired recreation settings. Treatment activities are based on general acceptance of insects and disease in MA 5.4, and additional factors, including the values of and risks to wildlife habitat and adjacent private lands, as well as public lands. Priority is given to areas in which values to be protected exceed the cost of protection. Activities minimize the risk of spreading the infestation, while still providing habitat for those wildlife species dependent upon the presence of insects and disease.

Human activities are managed in MA 5.41 so that deer and elk can effectively use the vegetation in the area (Forest Plan, page 3-57). Vegetation is managed in MA 5.42 and MA 5.43 to provide healthy plant communities with a variety of species present for food and cover; natural and created openings or meadows of various sizes and shapes occur (Forest Plan, page 3-60). Vegetation management in MA 7.1 will be designed to reduce fuel loading and meet visual objectives (Forest Plan, page 3-73). Ecological conditions and processes, including historic conditions, are likely to be permanently altered by human activities in MA 8.25 and MA 8.32 (Forest Plan, page 3-77).

Temporal Scope

This analysis considers effects on vegetation over a period of 5 to 20 years. Within 5 to 20 years, changed conditions, such as localized outbreaks of MPB, vegetation growth, fuels loading, or wildland fires, likely would need evaluation.

Geographic Scope

Vegetation resources in the proposed treatment units and along access routes that will be used for project activities may be directly affected. The project area may be indirectly and cumulatively affected.

Affected Environment

The affected environment for vegetation is presented in five sections: forested vegetation (including forest pests), special-status species, wetland and riparian areas, range resources, and noxious weeds and invasive species.

The project area covers 57,598 acres of NF administered lands. The most common cover types include aspen (23 percent), lodgepole pine (26 percent), spruce/fir and spruce/fir mixed (22 percent), and grass/forb (16 percent). **Figure 3–3** shows the distribution of lodgepole pine and quaking aspen in the project area. **Table 3–29** summarizes the cover types found on NF administered lands in the project area.

Table 3–29 Cover Types in the Project Area

Cover Type	Acres	Percent
Aspen	13,003	23
Grass/Forb	9,357	16
Lodgepole Pine	15,033	26
Mixed Conifer	469	<1
Mountain Shrub	1,150	2
Non-Vegetated	908	2
Pinyon/Juniper	30	<1
Riparian	457	<1
Sagebrush/Rabbitbrush	1,113	2
Spruce/Fir	12,623	22
Unclassified	3,455	6
Total Acres (NF Lands)	57,598	100

Forested Vegetation, Including Forest Pests

This section provides an overview of the current forest vegetation in the project area, including non-NF administered lands. A more detailed report can be found in the Forested Vegetation Report located in the *Project File*. Of the 57,598 acres within the project area boundary that are managed by the Forest Service, 41,615 acres are forested, primarily in lodgepole pine and quaking aspen.

Lodgepole Pine

Lodgepole pine stands comprise an estimated 36 percent of forested acres in the project area. Species composition of these stands is approximately 94 percent lodgepole pine, 4 percent Engelmann spruce, 2 percent subalpine fir, and minor occurrences of quaking aspen and Douglas-fir.

Mature trees dominate the age class distribution. Based on inventories, 91 percent of the lodgepole pine stands are more than 80 years old. Three representative areas were sampled in 2002 to collect age information: Whiskey-Stone-Martin, Vail Intermountain, and Piney. This survey indicates that the lodgepole pine stands average 121 to 165 years old. The uniformity of age distribution suggests that large-scale stand replacement events, likely wildland fire(s), occurred in the mid to late 1800s. Young stands created by past harvest activities, primarily clearcutting, account for an estimated 8 percent of the project area acreage. The remaining 1 percent is comprised of one stand that is an estimated 66 years old.

Lodgepole pine stands in the project area are fairly uniform in their structure. The average diameter at breast height (DBH) is 9.8 inches for trees greater than 5 inches DBH, totaling 228 square feet of basal area (BA) per acre. An average density of 432 trees per acre (TPA) creates a spacing of 10 by 10 feet. This size distribution is representative of the majority of lodgepole pine stands in the project area.

Except for scattered past clearcuts and ski runs, there are few to no large breaks in the current, single-story, closed-canopy condition. The mature lodgepole pine forests are arranged in a mix of small to very large contiguous single-story stands. There is not a mosaic of spatially distributed age classes, mix of differing diameters and heights, and canopy densities in the lodgepole pine landscape. The current MPB outbreak is beginning to create areas of dead and dying lodgepole pine that break up the continuity of the conifer canopy. These areas are not widespread, but if MPB remains unchecked, significant and extensive alteration of the lodgepole pine community is probable.

Quaking Aspen

The specific current condition of quaking aspen in the project area is not as well documented as lodgepole pine. Timber sales for merchantable aspen are not planned; therefore, no intensive stand exams have been conducted. Inventory data were collected for two aspen stands in the Vail Intermountain area and can reasonably represent aspen conditions for the immediate area.

Composition of the aspen stands to be treated by the project is approximately 92 percent aspen, 6 percent lodgepole pine, and a small number of Colorado blue spruce. The aspen component is primarily in the 6 to 12 inches DBH range (80 percent), with a fair amount of small regeneration under 2 inches in DBH (11 percent). Scattered individuals larger than 16 inches DBH are present.

Mature lodgepole pine scattered throughout these units is concentrated in trees larger than 8 inches DBH. Though not the dominant species, lodgepole pine is preventing the successful suckering of aspen by shading the ground and competing for resources.

Mountain Pine Beetle

A detailed report on MPB's history and current condition in the Vail Valley can be found in the *Project File*. A brief overview of MPB's life history, local history, current condition in the Vail Valley, management tools, and risk analysis is provided below.

Life History

MPB is a bark beetle indigenous to western North America. It attacks most species of western pines, most commonly ponderosa pine and lodgepole pine, throughout most of the ranges of these two host species.

The annual life cycle of MPB begins in mid-summer when adults emerge from now-dead trees. Females emerge first, and immediately begin searching for suitable live host trees. The females then burrow through the bark of selected trees, and in the process, produce pheromones that attract the males and additional females to the successfully excavated holes in the attacked tree. Common signs of attack are the small globules of pitch, called pitch tubes, which exude from the entrance hole. Healthy pines will repel the initial attack by producing copious amounts of resin that can force out the insects. If only a few beetles are successful in the initial attack, the tree will usually survive.

Breeding takes place in the cambium area, just beneath the outer bark. The fertilized female constructs a vertical gallery, or tunnel, upwards from the mating chamber, laying eggs in small niches. The eggs hatch into larvae, which then feed on the inner bark, at right angles to the brood gallery. Larvae continue to feed, lengthening their galleries through the fall until colder weather forces them to enter a dormant stage. In the spring, larvae resume feeding on the inner bark of the infested tree. The larvae pupate in mid-summer, mature into adults, and begin the cycle anew.

Figure 3–3 Lodgepole Pine and Quaking Aspen

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Adult beetles carry spores of a fungus (*Ceratocystis* spp.) on their bodies. This fungus invades the water-conducting tissues (xylem) of the host tree where it spreads to eventually interrupt the water supply of the tree. In addition, the feeding of larvae destroys much of the nutrient-conducting tissues (phloem). These two actions cause the death of the infested tree, usually during the spring and early summer of the year following the initial invasion. Because of this gradual reduction of water and nutrients, infested trees are recognized by the fading of the foliage through various stages of brown to red. Within a few years, the needles drop off and the standing dead lodgepole pine appear as tan or grey snags.

Local History

Most forest insect outbreaks occur in natural cycles that are important parts of forest ecosystems. MPB is a native component of western pine forest systems, and populations are almost always present at endemic levels, not readily obvious to the general public. The factors that first attract beetles to specific trees, or stands of trees, are poorly understood. However, there is little doubt that stressed trees are generally more susceptible to initial attacks than are healthy trees or stands of trees. MPB populations in Colorado's forests tend to increase in 15- to 20-year cycles of varying severity and longevity. In Eagle County and in adjacent Summit and Grand Counties, such outbreaks occurred in the late 1960s, ending about 1970, again in the early 1980s, ending about 1986 and now, in the early 2000s.

The last outbreak caused enough public concern that, in 1982, the Forest Service and the Colorado State Forest Service (CSFS), joined by the governments of Summit and Eagle Counties, towns and many homeowner groups, organized a large-scale control effort called the Summit-Upper Eagle Integrated Forest Management Project. Specific areas were designated for the various treatments, realizing that attempts to control the entire outbreak would be futile because of ownership patterns, varying interests, differences in values at risk, accessibility, and costs. Within the total area of 70,000 acres of pine forests, 19,000 acres were designated for the prescribed treatments. Approximately 6,000 acres were designated in Eagle County, from the 10,000-foot elevation contour on Vail Pass to Edwards and south to approximately Red Cliff.

Within the designated areas, the first concern was to reduce the population of beetles through various direct control (suppression) measures. Direct control entails finding currently infested trees (before the new adults emerge) and treating those trees in any of several manners that kill, or otherwise prevent emergence of, the developing beetles. As beetle populations were reduced, stand treatments were prescribed to improve the vigor of remaining trees.

In the first season, approximately 98,000 infested trees (about 98 percent of all discovered infested trees) were removed on lands of all ownerships within the designated areas in both counties, and about 1,050 uninfested acres were treated with preventive silviculture. In each of the following years the number of infested trees in the designated areas declined following continued treatment of those trees, while the general population levels of MPB outside the project area continued to thrive.

This successful joint program officially ended in 1986 with the recommendations to the various land owners/managers that forest management practices be continued throughout the area where stands remained susceptible to future MPB outbreaks.

In 1991, CSFS, High Country District began a systematic annual survey throughout Eagle and Summit Counties to monitor the endemic populations of MPB. The 1991 survey in Eagle County (primarily the Vail Valley and Meadow Mountain) located 128 infested trees in 21 separate locations. By 1994, 387 infested trees were identified. This report, as with previous and subsequent survey reports, was distributed to all interested parties. It should be noted that Vail Associates and the Town of Vail were fairly aggressive in treating reported infested trees within their respective jurisdictions.

Current Condition of MPB in the Vail Valley

In 1997, aerial mapping by the Forest Service counted more than 10,200 infested or faded trees in the Vail Valley, almost a hundred-fold increase since 1991. Ground surveys in 2001 and 2002 focused on the ski areas and lands adjacent to private residences. For these surveys, beetle infested trees are shown in **Table 3–30**.

Table 3–30 Ground Surveys of Beetle-Infested Trees

Location	Inventoried Infested Trees	
	2001	2002
Minturn, Grouse-Green Bear, southwest of Holy Cross District Office	108	NA[1]
Vail Ski Resort	474	630
Town of Vail	128	465
Beaver Creek Ski Resort	157	265
Total	867	1,360

[1] NA – Data not available

Approximately 1,383 acres in Whiskey-Stone-Martin area and 261 acres in the Vail Intermountain area were surveyed in 2001 (**Table 3–31**). During the 2002 field season, approximately 1,854 acres were surveyed in the same two locations. The results indicate that a significant number of trees, especially in the larger size classes, are under expanding pressure from MPB that is infesting or killing about 10 to 15 percent of the lodgepole pine per year. Preliminary observations in the summer of 2004 indicate that the area affected by MPB has expanded. Damage and mortality from MPB has continued within infested stands.

Table 3–31 Survey Results (Trees per Acre)

Area	Estimated Total Trees		Estimated Live Healthy Trees		Estimated Live Infested Trees		Estimated Dead-Beetle Killed Trees		11" DBH and Larger LP Trees		11" DBH and Larger LP-Infested or Killed by Beetle	
	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002
Whiskey-Stone-Martin	413[a]	370[b]	367	259	13	14	23 (10%)	18 (9%)	90	75	23 (26%)	23 (31%)
Vail Inter-mountain	366	448[c]	320	369	23	27	23 (12%)	45 (16%	106	78	35 (33%)	39 (50%)

[a] Total includes 10 trees that died from competition-induced pressure
[b] Total includes 79 trees other than lodgepole pine (LP)
[c] Total includes 7 trees other than lodgepole pine

Management Tools

Several control measures may be used to modify MPB activity. Generally, the feasibility of any technique relates to the size of the affected area and level of infestation. In currently infested stands, peeling the bark from harvested trees will successfully halt larval development and prevent further spread. However, this is very labor-intensive, and impractical on a large scale. Solar heating of infested logs is another effective control method, but is likewise labor-intensive and requires extended exposure to sunlight. The most cost-effective method of dealing with infested logs is to remove them from the forest

environment. In general, adult beetles will not successfully find new hosts if they emerge more than about 2 miles from host stands. Such "safe sites" can be located and "certified" by Forest Service or CSFS field personnel. Once hauled away, the logs can then become useful products.

Silvicultural thinning of infested stands has been shown to limit the spread and intensity of MPB outbreaks. Dense stands of large pines are most susceptible to MPB. Removal of larger, already infested pines and thinning the remaining trees will inhibit the spread of MPB within a stand by reducing MPB population densities. Thinning of uninfested stands, generally from below, has been shown to be effective in lowering MPB risk and preventing large-scale infestation of those stands.

Risk Analysis

The VVFH project proposes to modify MPB risk by thinning approximately 700 acres of lodgepole pine. MPB present in these stands is causing widespread mortality and is threatening to spread to adjacent stands. Risk to MPB outbreak can be quantified by modeling using the following criteria (McMahan et al. 2002):

- Percent of total basal area that is lodgepole pine
- Total stand basal area
- Total trees per acre
- Stand elevation
- Stand age
- Average diameter of lodgepole pine greater than five inches

The current risk of the stands proposed to be thinned is shown in **Table 3–32**.

Table 3–32 MPB Risk in Proposed Treatment Area Stands

Mountain Pine Beetle Risk	Acres
Extremely Low	0
Low	434
Moderate	262
High	0
Total	696[1]

[1] Rounded to 700 acres in Table 2-2.
Source: FVS model simulation for 2004

Habitat Structural Stage

Habitat structural stage (HSS) describes the size of the vegetation and the degree of vegetative cover of a community. HSS is widely used to evaluate the growth stage of a community and wildlife habitat. **Table 3–33** shows the ranges associated with each HSS classification.

Table 3–33 Habitat Structural Stages

HSS	Vegetation Type	Tree Diameter (inches)	Percent Cover
1	Grass/Forb	Not applicable	0-10
2	Shrub/Seedling	<1	11-100
3A	Poles/Saplings	1-9	11-40
3B	Poles/Saplings	1-9	41-70
3C	Poles/Saplings	1-9	71-100
4A	Mature trees	>9	11-40
4B	Mature trees	>9	41-70
4C	Mature trees	>9	71-100
5	Old Growth	>9	11-100

Existing conditions were modeled using the Forest Vegetation Simulation (FVS). Modeling data are available only for the proposed lodgepole pine and aspen treatment units. **Table 3–34** shows the distribution of HSSs within proposed forested treatment units in 2004. The majority of the forested cover types are in the intermediate (HSS 3C) and late-successional stages (HSS 4B-4C).

Table 3–34 Habitat Structural Stages for Proposed Aspen and Lodgepole Pine Treatment Units (Acres)

Tree Species	Habitat Successional Stage								
	Unknown	2	3A	3B	3C	4A	4B	4C	Total
Aspen	160[1]						71	139	370
Lodgepole Pine					11		95	590	696[2]

[1] Figure represents aspen patch cuts for which inventory data are not available.
[2] Lodgepole pine treatment area is rounded to 700 acres in Table 2-2.
Source: FVS model simulation for 2004.

Special-Status Species

There are no endangered plant species known to occur in the WRNF. One threatened plant species is known to occur on the WRNF; however, this species, the Penland alpine fen mustard, is not known to occur in the project area. There are 19 Forest Service Region 2 sensitive plant species known to occur in the Forest. One sensitive species, Harrington's beardtongue, is known to be scattered throughout sagebrush habitat, and may possibly occur within the project area. There is potential habitat for three other sensitive species: Rocky Mountain thistle on adobe hills; Colorado tansy-aster at high elevations in dry tundra; and Porter's needle grass in wetland habitats. There are no additional plant species of viability concern in the project area.

Wetlands and Riparian Areas

In the project area, there are numerous small wet areas or water-influenced habitats. These include wet meadows, seeps, springs, riparian areas, and other saturated soils. The only mapped wetlands within proposed treatment units are located in aspen treatment units. These are summarized in **Table 3–35**. The *Project File* contains the locations of other small, unmapped water features such as seeps, springs, or wet scarps that exist in the vicinity of the treatment units. Riparian areas were not identified separately, although the WIZ described under Streams and Watershed earlier in this chapter includes riparian areas. Although these water-influenced habitats only represent a small fraction of the project area, they are used

by a disproportionate number of wildlife and plant species. Riparian and wetland habitats in the project area provide habitat for nesting and migratory birds, amphibians, and a variety of mammal species. These habitats provide suitable cover, water, and foraging for elk and deer in the project area. They are also areas of greater plant diversity.

Table 3–35 Wet Areas within Proposed Treatment Units

Type of Area	Unit(s) Affected
Head Cut	204
Scarp	203
Seep	201
Seep or Spring	201
Seep or Wallow	201
Sinkhole	211, 212
Wetland or Wet Area	201, 211
Wet Meadow	211
Wet Slope	201

Rangeland Resources

There are two sheep allotments in the project area – the Red and White Mountain allotment and the Meadow Mountain allotment. The Red and White Mountain allotment north of I-70 and west of Booth Creek contains 38,242 acres. This allotment supports 2,900 head of sheep from July 1 through September 20. The second allotment, Meadow Mountain, contains 24,952 acres. This allotment supports 800 head of sheep from June 13 through September 25. Sheep typically graze in the Meadow Mountain area during the first 2 to 3 weeks of July, then move to Two Elk Creek and return around the middle to end of September.

Noxious Weeds and Invasive Species

The project area was inventoried in 2003 to provide an overview of current populations of noxious weeds. These inventories did not include private land. Existing roads were driven, and field crews inventoried areas within and adjacent to potential treatment units to determine the extent of noxious weed infestations. Existing noxious weed infestations were mapped and included in the noxious weed database. Species found included Musk thistle, houndstongue, Dalmatian toadflax, bull thistle, Canada thistle, common tansy, diffuse knapweed, hoary cress, mayweed chamomile, oxeye daisy, perennial pepperweed, plumeless thistle, Russian knapweed, and yellow toadflax. An estimated 1,340 acres within the project area are infested with noxious weeds. Approximately 800 infested acres are within one-half mile of proposed treatment areas.

Environmental Effects

Direct and Indirect Effects by Alternative

The purpose and need for the project is to reduce the current level of MPB and future MPB risk, and reduce wildland fire hazards in the project area. Natural processes controlling the influence of these factors would continue under all alternatives. New growth and mortality, both at the scale of single trees and stands, would add fuels to the system. Populations of MPB would be present in the stands, even following implementation of the action alternatives. The extent to which these factors would shape future forest structures would depend on the chosen alternative.

Alternative A – No Action

Under Alternative A, the No Action alternative, no treatments would be implemented that would alter species diversity. The current acreage and distribution of cover types would remain unchanged until a landscape-level disturbance, such as wildland fire or another MPB outbreak, occurs. Successional pathways would not be altered, and stand-level species composition changes would proceed naturally. Species diversity likely would not change significantly without a landscape-level disturbance or vegetation management.

This alternative also would not directly alter the current distribution of HSSs. Natural processes such as succession, tree growth, and mortality would dictate HSS. MPB would continue to kill overstory trees creating gaps and reducing canopy closure. Mature stands with low or endemic MPB populations would graduate into higher HSSs. Younger stages would mature into higher stages as trees grow and the canopy closes. Other than areas of high MPB-induced mortality, forest openings would neither be created nor maintained. The 20-year projection of HSS distribution under Alternative A is shown in **Table 3–36**. Figures for lodgepole pine are growth models predicted without MPB-induced mortality. Lodgepole pine structure following an MPB outbreak would be categorized as 3B or 3C, as the majority of trees greater than 8 inches DBH would be killed.

Table 3–36 Habitat Structural Stages for Proposed Aspen and Lodgepole Pine Treatment Units in 2024 for Alternative A (Acres)

Species	Unknown	2	3A	3B	3C	4A	4B	4C	Total
Aspen	160[1]							210	210
Lodgepole pine					11			685	696[2]

[1] Represents aspen patch cuts in Whiskey-Stone-Martin area for which inventory data is not available.
[2] Lodgepole pine treatment area is rounded to 700 acres in Table 2-2.
Source: FVS model simulation for 2024.

Because no aspen enhancement would take place under this alternative, successional pressure from encroaching pines would continue to hinder aspen recruitment and impact aspen vigor. In the absence of disturbance, lodgepole pine and other conifers would eventually replace aspen. The functionality of the aspen-dominated stands as forested fuelbreaks would decline over time, and eventually become negligible as encroaching conifers replace aspen.

No treatment would take place that would alter the current or future risk of MPB outbreak. Lodgepole pine stands currently infested by MPB would continue to decline in health, and infested trees would die, adding to surface and standing fuel loads. Uninfested trees would continue to grow larger and denser, increasing the likelihood of an outbreak.

This alternative also could affect surface water, wetlands, and the spread of noxious weeds. Increased vegetation due to the absence of cutting and burning could result in increased water uptake. This could result in decreased surface water and reductions in wetland area. Conversely, areas with high mortality may experience reduced uptake before new vegetation becomes established. Although no management activities would occur in addition to ongoing activities, the potential for the spread of noxious weeds would remain high in non-forested areas due to existing seed sources.

There are few risks to sensitive species under the No Action alternative. Current management activities prevent or reduce impacts to these species and their habitats. MPB mortality and increased fire hazards over time would not affect these species because their habitats occur in high elevation areas, wetlands, shrublands, and barren slopes. These areas typically do not carry fires well, with the exception of

shrublands. These areas may burn, but no more than historically, to which these species are adapted. The determination is that implementation of the No Action alternative would have no effect on sensitive species of plants.

There would be no reduction of fuels or establishment of fuelbreaks under Alternative A. Existing wildland fire hazards would increase as fuel levels increase over time. Should a wildland fire occur under this alternative, larger volumes of accumulated fuels could be consumed by fire and result in larger or more severe fires that could have a greater effect on vegetation in the project area.

Alternative B

Alternative B involves thinning, patch cuts, sanitation, and salvage in lodgepole pine treatment units, and some level of environmental disturbance can be expected during operations. A system of temporary roads would be established to remove trees that are cut. Even with mitigation measures, temporary roads may take longer to return to a natural condition than the treatment unit itself. Logging activity in lodgepole pine treatment units would be evident for several years while new vegetation becomes established. Lodgepole pine treatments would not alter species diversity, but create a more disturbance-resistant stand by decreasing tree density.

Alternative B also would involve cutting aspen where aspen stands can be renewed and enhanced as natural fuelbreaks. In the Vail Intermountain area, all work would be accomplished without constructing temporary roads for aspen treatment units. Aspen treatments designed to maintain or increase species diversity would positively affect forest diversity. Aspen stands in poor health under significant pressure from encroaching lodgepole pine would be enhanced. This treatment would make more sunlight, water, and nutrients available to the remaining aspen, thus promoting suckering and maintaining aspen dominance.

Lodgepole pine treatments would create a more outbreak-resistant stand structure in the long term by modifying future MPB risk. In the short term, thinned stands will continue to experience yearly infestations of MPB, but at lower damage levels than adjacent, untreated stands. All merchantable, heavily infested trees would be removed, along with merchantable snags, thus reducing MPB numbers and available host trees for MPB. Thinning from below would decrease competition for resources, enabling the remaining trees to better resist MPB attack. Aspen patch cuts would break up forest continuity, which could inhibit the spread of MPB. **Table 3–37** shows the MPB risk for the lodgepole pine stands 20 years post-treatment. A stand does not have to be rated at a high risk to become infested and damaged by MPB. Stands at moderate and even low risk have become infested by MPB densities reaching outbreak levels. Populations of MPB would remain following treatment, as complete removal of MPB is not feasible. Areas treated with sanitation and salvage would be the most resistant to future MPB outbreaks as the majority of the preferred MPB host trees would have been removed. Localized outbreaks may occur despite treatment and could require small-scale control operations.

Table 3–37 Current MPB Risk and 20-Year Projections (Acres of Lodgepole Pine)

Risk	Current Condition- 2004	Alternative A- 2024	Alternatives B, C, and D- 2024
Extremely Low	0	0	0
Low	434	434	546
Moderate	262	262	150
High	0	0	0
Total[1]	696	696	696

[1] Rounded to 700 acres in Table 2-2.

Alternative B would not affect three of the four sensitive species of plants. All treatments would occur below the lower elevation limit for Colorado tansy-aster populations on the Forest. Porter's needle grass occurs on wetlands, which would be avoided under Alternative B. Rocky Mountain thistle occurs on erosive slopes, where treatments would not occur on unstable soils. Harrington's beardtongue occurs in sagebrush habitats that would be affected by Alternative B. **Table 3–38** shows the determinations for all four sensitive plant species by alternative.

Table 3–38 Determination of Effect on Sensitive Plants

Species	Alt B	Alt C	Alt D
Harrington's beardtongue	MAII[1]	MAII[1]	MAII[1]
Rocky Mountain thistle	NI[2]	NI[2]	NI[2]
Colorado tansy-aster	NI[2]	NI[2]	NI[2]
Porter's needle grass	NI[2]	NI[2]	NI[2]

[1] May adversely impact individuals
[2] No impact

The only wetlands noted within treatment units are within aspen treatment units. Small, unmapped seeps, springs, swales, or other water features may exist within any proposed treatment unit. All project activities would avoid wetland areas and moist soils, where possible, as described in the design criteria within **Appendix D**.

Current management activities on the two grazing allotments within the project area could proceed under Alternative B with no noticeable effect on the grazing of sheep. Prescribed burns associated with the project would likely occur in the spring before sheep are turned out on the affected allotments, or in the fall, after sheep have left. Prescribed burn areas are not in areas presently grazed by sheep or can be avoided. If treated within the grazing season, the permittee should be notified. Total acreages of the proposed treatments are very small, 5 percent of the total acreages of the allotments.

Lodgepole pine treatment units located south of I-70 and within approximately 1 mile west of U.S. 24 are particularly vulnerable to infestation by noxious weeds. Approximately 800 acres within one-half mile of treatment areas are infested with noxious weeds. Of the acres infested, 106 acres contain yellow toadflax, oxeye daisy, Russian knapweed, diffuse knapweed, and common tansy. Areas near these infestations are particularly vulnerable to colonization. Much of this acreage is located west and south of the junction between I-70 and U.S. 24. Although dense forest is unlikely to be overtaken with the species present, there is still potential for other habitats to be altered by colonization of these species. Surface disturbance exposing mineral soil would create potential for new infestations. The treatment units north of I-70 currently show no significant noxious weed populations. Disturbances such as burning would increase an area's susceptibility to colonization by noxious weeds. Revegetation, as well as treatment of known populations, can reduce the likelihood of colonization after disturbance.

Alternative B would include the construction of at least 10 miles of temporary roads and some potential trail use. The revegetation of roads and trails will help to reduce the risk of noxious weed spread. Proposed temporary roads constructed within one mile of U.S. 24 have the potential to act as corridors for the spread of noxious weeds due to the existing infestations within this area. Travel between and through these known infestations will comply with weed management guidelines in order to avoid the spread of weeds into unaffected sites.

Under Alternative B, 30 to 50 percent of the lodgepole pine basal area would be cut to remove trees infested with MPB and create a more outbreak-resistant stand structure. The most susceptible, dense groups of large lodgepole pine would be patch cut or opened up to basal areas less than 100 square feet per acre to hinder the spread and potential damage from MPB. Aspen patch cuts would remove

encroaching pines and aging aspen in poor condition. This would promote aspen regeneration and maintain aspen dominance at the stand level. At the wildland urban interface, these improved aspen stands would act as fuelbreaks, slowing advancing wildland fire. Aspen patch cuts within the lodgepole pine landscape would disrupt MPB spread by maintaining breaks in the lodgepole pine canopy. This could also inhibit the advance of crown fires.

Lodgepole pine treatments would reduce overall stand density by thinning 30 to 50 percent of the basal area from below. This would reduce the majority of stands to HSS 4B, and one 11-acre stand to 3C. The 20-year projection for HSS distribution in lodgepole pine units is shown in **Table 3–39**. In areas of high MPB damage and mortality, up to 70 percent of the basal area may be thinned from above by sanitation and salvage treatments. This is the portion of the stand that is most severely impacted by MPB, and would likely die should the infestation progress. Areas treated with sanitation and salvage would be converted to HSS 3B, 3C, or 4B, depending on the level of infestation.

Of the 370 acres in aspen treatment units, 160 acres would be in small patch cuts within lodgepole pine units and would be converted to HSS 2. The remaining 210 acres of aspen would be located in the Vail Intermountain area, including a fuelbreak along the boundary of the Game Creek inventoried roadless area. The 20-year projection of HSS distribution in aspen units under Alternative B is shown in **Table 3–39**. Alternative B would significantly open the treated aspen units, which is reflected by the projected increase in HSS 3C in **Table 3–39** compared with the 20-year projection for Alternative A. This enhancement would enable the aspen to retain dominance by removing pine encroachment, allowing these areas to serve as forested fuelbreaks.

Table 3–39 Habitat Structural Stages for Proposed Aspen and Lodgepole Pine Treatment Units in 2024 for Alternative B

Species	2	3A	3B	3C	4A	4B	4C	Total
Aspen	160[1]			139			71	370
Lodgepole pine				11		113	572	696[2]

[1] Represents aspen patch cuts for which inventory data is not available. Insufficient data to model HSS for the patch cuts. HSS is estimated.
[2] Lodgepole pine treatment area is rounded to 700 acres in Table 2-2.
Source: FVS model simulation for 2024.

Aspen treatment units in the Vail Intermountain area totaling 210 acres would be thinned to promote aspen regeneration and remove pressure from encroaching pines. This area would then serve as a forested fuelbreak protecting both the forest interior from a roadside ignition and structures at the wildland urban interface from a fire advancing from the interior. An additional 160 acres of small aspen patches interspersed within the lodgepole pine would be enhanced in the same manner. These patches would provide the added benefit of breaking up the forest canopy, potentially hindering the spread of MPB. Both areas of aspen enhancement, including patches in the forest interior and larger units at the wildland urban interface, would need to be monitored and maintained as the natural successional pathway of pine encroachment would resume once the project is completed.

The effects of wildland fire under Alternative B would be similar to Alternative A, but reduced fuel loads and enhanced fuelbreaks under Alternative B may lessen the severity or extent (acres) of the burn, reducing the effects on vegetation.

Alternative C

The effects under Alternative C would not differ significantly from Alternative B for forest vegetation resources. Under Alternative C, approximately 10 additional acres of lodgepole pine would be removed to

accommodate a cable system to remove harvested trees from Units 101 and 102. Alternative C also proposes 0.7 mile of temporary roads between Units 101 and 105, and 102 and 104, as well as 1.8 miles of potential cable corridors and tractor trails.

Mechanical fuel treatments under Alternative C could potentially cause more harm to Harrington's beardtongue due to increased surface disturbance. This alternative also would create slightly more disturbed soil associated with temporary roads, landings, cable corridors, and tractor trails. These facilities as well as heavy machinery use, could impact the sagebrush habitat of Harrington's beardtongue.

Alternative D

Alternative D would treat the same lodgepole pine units as Alternative B, but aspen enhancement would be reduced by 160 acres to approximately 210 acres. The aspen treated under this alternative would be 160 acres in the vicinity of the lodgepole pine units, a 200-foot wide area along the boundary of the Game Creek inventoried roadless area. and private and county lands in the Vail Intermountain area. Alternative D poses the least threat to mapped wetlands due to the decreased treatment acreage. The effects of Alternative D would be the same as those for Alternative B, but on 160 fewer acres of aspen. The untreated aspen acreage would be left to natural processes including succession to pine. This conversion to pine would reduce aspen's function as a forested fuelbreak.

Cumulative Effects by Alternative

Alternative A – No Action

Effects from ongoing activities on public and private lands and future activities on private lands within the project area would contribute to cumulative impacts on vegetation resources in the project area, however, natural ecological disturbances would be the dominant agent of change affecting vegetation in the project area. Landscapes outside the HRV and those shifting outside the HRV would continue along these trends unless restored by a natural disturbance, such as a wildland fire.

Increased maturity and canopy closure would become more prevalent in the project area over time. Insects and disease would operate relatively free from human influence; MPB would continue to impact lodgepole pine stands. Stands infested with MPB would continue to decline in health, with the largest lodgepole pines succumbing first followed by most trees more than 8 inches DBH. Natural succession of stands, including conifer invasion of aspen stands and juniper encroachment in shrublands, would continue. Existing wildland fire hazards would increase as fuel levels increase over time as MPB kills overstory trees and they deteriorate. Portions of the project area would become increasingly susceptible to large stand-replacing fires.

Table 3–40 shows past harvest activities within the project area. Approximately 660 acres, or 1.5 percent of the forested portion of the project area, have been harvested over the past 22 years. The cumulative effects of these activities on vegetation resources should be very small and short-lived, based on the acres involved and the effective and comprehensive implementation of design criteria and BMPs for these past and ongoing activities.

Table 3–40 Past Harvest Activities in the Project Area

Timber Sale Name	Year Cut	Cover Type	Cut Acres	Type of Harvest
Red Sandstone # 5	1982	LP	12	Clear Cut
Martin Timber Sale #8	1983	LP	5	Clear Cut
Martin Timber Sale #4,5,6,7	1983	LP Mix	47	Clear Cut
Grouse #1	1984	LP	55	Partial Cut-Shelterwood Seed Cut
Grouse #3	1984	LP	15	Clear Cut
Grouse #4	1984	LP	36	Clear Cut
Hay Meadow Timber Sale # 3	1985	LP	13	Clear Cut
Hay Meadow Timber Sale #2	1985	LP	3	Clear Cut
Grouse #2	1985	LP	15	Clear Cut
Grouse #5	1985	LP	11	Clear Cut
Meadow Mountain #1	1987	LP	10	Clear Cut
Red Sandstone #1,2,3,4	1987	LP	32	Clear Cut
Red Sandstone #7	1987	LP	2	Clear Cut
Hay Meadow Timber Sale #1	1987	LP	42	Partial Cut
Meadow Mtn Unit #1,2	1987	LP	21	Clear Cut
Red Sandstone #6	1989	LP	7	Clear Cut
Red Sandstone #8, 9	1988	LP	18	Clear Cut
Buffer #11	1990	LP	40	Clear Cut
Buffer #10	1990	LP	11	Clear Cut
Buffer #10	1990	LP	11	Clear Cut
Buffer #8	1991	LP	37	Clear Cut
Buffer #7	1991	LP	21	Clear Cut
Buffer #9	1992	LP	16	Clear Cut
Back Door #3	1999	LP	10	Sanitation/Salvage
Back Door Salvage Sale #1	1999	LP	3	Sanitation/Salvage
Back Door Salvage Sale #1	1999	LP	3	Sanitation/Salvage
Back Door Salvage Sale #2	1999	LP	56	Sanitation/Salvage
Green Bear Salvage Sale	2001	LP	30	Sanitation/Salvage
Green Bear Salvage Sale	2001	LP	9	Sanitation/Salvage
Vail Ski Area	2001	LP	69	Sanitation/Salvage

Note: LP = lodgepole pine

Public scoping began for the Piney River Project in March 2004 and ended in April 2004. Approximately 1,900 acres of lodgepole pine forest just north of the project area would be harvested under the Piney River Project. Though not completely within the project area, the objectives are similar, reinforcing the desire for a more MPB resistant forest as a whole.

Alternative B

The proposed project would add to past and ongoing silvicultural projects with similar objectives. The proposed project would add approximately 1,120 acres of forest vegetation treated by silvicultural projects. The cumulative harvested area would be less than 4 percent of the project area. The cumulative effects of these activities on vegetation resources should be very small and short-lived, based on the acres involved and the effective and comprehensive implementation of design criteria and BMPs for past and ongoing activities and design criteria for the proposed project described in **Appendix D**.

The current structure of many lodgepole pine treatment units is far above what would be considered a low risk for MPB outbreak. In these dense stands, decreasing basal area and tree density to acknowledged lower-risk levels in a single treatment would raise concerns regarding visual quality and potential windthrow. Seven of the proposed lodgepole pine treatment units would be thinned to 75 square feet of basal area per acre, and the remaining 14 units would be thinned to 100 or 125 square feet per acre (**Table 3–41**). These 14 units, despite treatment, may still be at a greater risk to MPB outbreak than those thinned to a lower basal area. Several stands have been identified through field observations to have recently declined in health significantly due to high MPB populations. It is reasonably foreseeable that these stands (104, 105, 106, 117, 118, 119, 123, and 128) would receive a higher proportion of sanitation and salvage than the treatment identified in **Table 3–41**. By the time the project is implemented, it is expected that areas requiring sanitation and salvage will be more extensive than the current condition, and additional units or portions of units will require sanitation and salvage for adaptive management. Despite these treatments, it is foreseeable that, given stand conditions and local trends in MPB activity over the next 10 years, additional treatments may be necessary to further reduce future MPB risk. After the completion of lodgepole pine treatments under Alternative B, the treatment units would be monitored, and the effectiveness of the treatments evaluated. Should it be determined that additional treatments are necessary, the appropriate effects analysis will be completed. Possible re-entry after 10 years into the lodgepole pine treatment units where ladder fuels need treatment or not enough basal area was removed under Alternative B to effectively modify future MPB risk are not expected to result in cumulative conditions that would exceed the project-only effects for the lodgepole pine treatments.

Infestations of noxious weeds may result from vehicle traffic that originates from areas outside the project area where noxious weeds may already exist. Most of the transported seed would establish on or along road corridors. Wind, or other methods of dispersal, may introduce noxious weeds to areas of the forest interior. If left unchecked, the spread of noxious weeds could displace native plants. The species of weeds found within the project area will not spread into adjacent, dense, closed-canopy timber stands, but can spread to grasslands, shrublands, and meadows. Once established, they can become a dominant vegetative component, displacing native plant species and adversely affecting the wildlife and insects dependant on that native vegetation. Desirable forage species may be replaced with undesirable species. Noxious weeds can also affect ecosystem function. Depending on the species of weeds, erosion rates as well as burn cycles can be adversely affected. Design criteria that would limit the spread of noxious weeds are detailed in **Appendix D**.

Two sheep grazing allotments occur within the project area; Red and White Mountain and Meadow Mountain. These would be grazed from July 1 through September 20 and June 13 through September 25, respectively. Allotments would not show obvious signs of use after sheep have moved through an area. Management would maintain current grazing regimes, resulting in similar output and production.

Table 3–41 Proposed Lodgepole Pine Treatments by Unit

Unit	Area (acres)	Basal Area in 2004	70% of Basal Area	50% of Basal Area	Target Basal Area	% Basal Area Removed
102	40	133.3	93.3	66.6	75	43.7
116	16	149.1	104.4	74.6		49.7
121	29	120.2	84.2	60.1		37.6
126	10	128.5	90	64.3		41.6
127	18	126.3	88.4	63.2		40.6
128	29	113.4	79.4	56.7		33.8
129	37	106.6	74.6	53.3		29.6
101	33	178.1	124.67	89.05	100	43.9
103	25	183.9	128.8	92		45.6
115	48	155.2	108.6	77.6		35.6
117	22	182.4	127.7	91.2		45.2
119	21	182.4	127.7	91.2		45.2
123	38	189.2	132.4	94.6		47.1
124	15	191.3	133.9	95.6		47.7
125	18	164.5	115.2	82.3		39.2
104	42	206.5	144.6	103.3	125	39.5
105	45	218.2	152.7	109.1		42.7
106	26	210.9	147.6	105.4		40.7
118	127	180.1	126.1	90		30.6
120	46	245.2	171.6	122.6		49
122	11	244.8	171.4	122.4		48.9

Alternative C

The cumulative effects for Alternative C would vary only slightly from those described above for Alternative B. Under Alternative C, overmature and decadent shrublands north of the I-70 corridor would not be replaced by young vegetation, since broadcast burning would not occur.

Alternative D

The cumulative effects for Alternative D would vary only slightly from those described above for Alternative B. Alternative D may not have any noticeable effect on the vigor or size of aspen stands in the Vail Intermountain area, and may not retard the encroachment of conifers.

Forest Plan Consistency

All alternatives meet the management direction contained in the Forest Plan and are consistent with management area standards and guidelines highlighted at the beginning of this chapter as they pertain to vegetation management.

Irreversible and Irretrievable Commitments

No irreversible or irretrievable commitments of forest vegetation would result from the proposed project. Trees are a renewable resource allowing flexible management strategies designed to meet changing forest conditions. Any forest resources removed by implementing the project would be recuperated naturally in the time frame of forest growth.

3.3.3 Fire and Fuels

Resource Description

The purpose and need of the project is driven by the need to reduce fuels in the project area. This section describes the vegetation environment in the project area as it relates to providing fuel for a wildland fire. Fuels are evaluated to determine the most effective strategy for minimizing wildland fire hazards. Project activities can potentially affect the intensity of wildland fire in the project area, including the wildland urban interface.

Indicators

- Change in fuel loading
- Acres treated by broadcast burns
- Acres treated by mechanical methods
- Change in predicted fire behavior
- Change in predicted flame length
- Change in predicted rate of spread
- Aspen fuelbreaks, measured as acres treated
- Fuelbreak created at wildland urban interface, in acres

Forest Plan Direction

The overall direction for managing wildland fire within the WRNF is based on the national strategic goals to protect, maintain, and enhance forest resources through fire protection and the use of prescribed fire. The WRNF fire management program has identified prescribed fire and mechanical treatment as means to protect and enhance resources on the Forest (Forest Plan page 3-367). Cost-effective wildland fire protection, the use of prescribed fire, and reducing the hazards and consequences of wildland fire within or escaping from wilderness are all components of wildland fire planning (Forest Plan, page AA-3). The development and maintenance of fuel profiles that contribute to a cost-effective program is a key goal of fuel management (Forest Plan, page AA-5). Prescribed fire should be used in a safe, carefully controlled, cost-effective manner to achieve Forest Plan objectives (Forest Plan, page AA-10).

Forest-wide objectives and strategies include increasing the amount of forest and rangelands restored to or maintained in a healthy condition with reduced potential for damage from fires, insects, disease, and invasive species; placing high priority on fuel reduction activities in wildland urban interface areas; implementing management practices, including prescribed fire, that will move landscapes toward desired condition for vegetation, as described in the MA descriptions and HRV; and working cooperatively with others across landscapes to promote ecosystem health (Forest Plan, pages 1-8 and 1-9). Forest-wide guidelines for fire management (Forest Plan, page 2-29) apply to all areas of the Forest and include: minimizing the exposure of firefighters and the public to fire hazards; using prescribed fire where appropriate to accomplish management goals and objectives; minimizing ground-disturbing activities; using fire management activities to sustain ecosystems; and managing ignitions in areas covered by specific fire use plans to accomplish resource management objectives.

Additional guidance is found in the *Eagles Nest and Ptarmigan Peak Wilderness Fire Management Guidebook for Wildland Fire Use* adopted in March 2001. This guidebook provides direction for management of naturally-ignited fires and fuel treatment to reduce hazards. The project area is located in the Booth Fire Management Unit.

Desired Condition

The purpose of fire and fuels management in the project area is to reduce the threat of a catastrophic wildland fire from reaching private property. By reducing the accumulation of fuels, vegetation treatments could decrease the intensity of future wildland fires. These treatments, both mechanical fuel reduction and prescribed fire, could also decrease the extent of fast-moving crown fires occurring in the project area. The desired condition of the project area would reduce the intensity and extent of future wildland fires, thus increasing the likelihood that life and property can be defended safely.

There is no management area direction specific to fire and fuels in the project area. MA direction that could affect management of fire and fuels is summarized below.

- 1.12 Primitive Wilderness – Fire and fuels are managed to minimize impacts to trails in order to protect scenic resources.
- 1.2 Recommended for Wilderness – Fire and fuels are managed to protect wilderness characteristics.
- 1.31 Backcountry Recreation, Non-Motorized – Fire and fuels are managed to allow for a variety of year-round non-motorized recreation opportunities in a natural or natural-appearing setting. No road building occurs in the area.
- 5.4 Forested Flora and Fauna Habitats – Fire and fuels are managed to provide a mix of ecological and human needs.
- 5.41 Deer and Elk Winter Range – Fire and fuels are managed to provide adequate amounts of quality forage, cover, and solitude for deer, elk, and other species. Activities that would disturb deer and elk are restricted during winter and spring periods.
- 5.42 Bighorn Sheep Habitat – Fire and fuels are managed to provide healthy plant communities for food and cover. Fire plans are developed in support of habitat improvement.
- 5.43 Elk Habitat – Fire and fuels are managed to provide for low road densities and optimum forage and cover ratios. Activities are restricted during certain times of the year depending on the area under consideration.
- 7.1 Intermix – Fire and fuels management activities must be coordinated with affected landowners. Management guidelines also specify minimizing the potential for insect and disease outbreaks through vegetation treatments.

Temporal Scope

Project activities could affect fire and fuels management for 2 to 10 years after treatments are implemented. The effects of project activities would last as long as the treatments reduce the potential hazard and intensity of wildland fires.

Geographical Scope

The area analyzed for fire and fuels is the project area, focusing on treatment units. Landscape-level conditions outside treatment units are described to place the project in context and establish fire patterns and history within the Vail Valley.

Affected Environment

This section presents the affected environment as it relates to fire and fuels, including a discussion of fire history, fire regimes, fuel models, fire weather, fire behavior, and fire risk in the project area. More detailed information is available in the *Project File*.

Fuels analysis in the project area has been divided into two areas, north and south of I-70. The fuels north of I-70 consist primarily of shrublands and aspen; fuels south of I-70 are comprised predominantly of mature conifer stands, most of which are lodgepole pine. Scattered aspen stands of various ages are intermixed with the lodgepole pine.

Fire History

Vegetation north of I-70 consists primarily of shrublands and aspen. In the pre-settlement era, fire intervals in mountain big sagebrush communities ranged from 15 to 25 years. Mountain big sagebrush sites in southwestern Idaho show evidence of about three to five fires per century before 1910. Very frequent fire suppresses mountain big sagebrush establishment, while long fire return intervals promote tree invasion into mountain big sagebrush communities. An average fire interval of about 20 years has proven sufficient to control mountain big sagebrush invasion in southwestern Montana grasslands (Arno and Gruell 1983).

Fire exclusion has led to invasion of mountain big sagebrush communities by western juniper. Mountain big sagebrush can be a nurse plant for western juniper. Sparse under pre-settlement fire frequencies of 15 to 25 years, western juniper has formed dense stands on former mountain big sagebrush communities in the Great Basin. Fire frequencies of 30 to 40 years would control western juniper expansion onto mountain big sagebrush communities (Burkhardt and Tisdale 1976).

It appears that successful, aggressive fire suppression in the past 60 years has affected the shrublands north of I-70. Within the project area, isolated juniper trees can be found in the shrublands.

Vegetation south of I-70 is dominated by lodgepole pine, quaking aspen, and other conifers. Fire regimes in lodgepole pine-dominated communities vary greatly in the Rocky Mountains. In areas with dry summers, low to medium-intensity ground fires occurred at intervals of 25 to 50 years. In areas with moist summers, however, sparse understories and slow fuel buildup result in less frequent, but more intense fires. Stand-replacing fire intervals can vary from less than 70 to more than 300 years.

Fire in lodgepole pine stands generally either smolders in duff for extended periods or quickly develops into rapidly spreading wildland fires. Smoldering fires are common in lodgepole forests because understory fuels are sparse. However, lodgepole pine stands become more flammable as they age because dead woody fuels accumulate on the forest floor, and spruce, fir, and lodgepole pine regeneration becomes established, forming ladder fuels. These fuels result from past fires, insect and disease outbreaks (especially from MPB), and over-maturity. In general, the potential for high-intensity crown fires is great twice in the life of a stand. The first period is in young stands, when the crowns of the growing lodgepole pine are in close proximity to dead, woody fuels. The second time is when over-mature stands break up and are replaced by shade-tolerant associates. During this period, dead fuels accumulate as lodgepole snags fall, and young, shade-tolerant conifers provide a fuel ladder to the crowns of overstory trees.

Within the project area, inventoried stand structure is consistent with a fire regime that has a slow fuel buildup that results in infrequent but very intense fires. In these lodgepole pine forests, it may take more than 300 years for fuels to accumulate and sustain a stand-replacing crown fire. Ongoing infestation of MPB is adding fuels to some areas both as standing dead trees and ground fuels, accelerating the fuel-loading process. The primary concern is smaller fuels mixed with the eventual establishment of younger trees, increasing ladder fuels and the likelihood of a surface fire transitioning into the canopy.

It appears that effective fire suppression in the past 60 years has not affected the lodgepole pine stands in the project area with respect to HRV. This is not surprising given the 100 to 500 year fire interval associated with this type of vegetation (Turner et al. 2003).

Fire Regimes

A fire regime is a generalized description of the role that fire plays in an ecosystem. Many methods are available for quantifying and describing fire regimes. The fire regimes identified for the project area were selected using the methodology presented in the National Fire Plan. The five combinations of fire frequency and severity that compose fire regimes are defined in **Table 3–42**.

Table 3–42 Fire Regime Groups

Fire Regime Group	Fire Frequency	Fire Severity	Representative Vegetation
I	0 – 35 years	Low Severity	Low Elevation Ponderosa Pine and Dry-site Douglas-fir
II	0 – 35 years	Stand Replacement	Chaparral, Grass/Sage
III	35 – 100 years	Mixed Severity	Mixed Shrub, High Elevation Ponderosa Pine, Oak
IV	35 – 100 years	Stand Replacement	Pinyon-Juniper, Aspen
V	> 200 years	Stand Replacement	Lodgepole Pine, Spruce/Fir

There are three condition classes that describe the fire regime with respect to the HRV of the vegetation. Condition classes help define the importance of fire frequency with respect to the ecosystem. The three potential condition classes are described below.

Condition Class 1 — Low-severity fire leaves the soil intact and poses little risk to the ecosystem. Species are adapted to withstand periodic fires. Fire regimes are within the HRV. Vegetation attributes (species composition and structure) are intact and functioning within the HRV. (Example: open stands of mature ponderosa pine where historical fire regime is replicated through periodic application of prescribed fire or allowing natural fires to burn.)

Condition Class 2 — Fire regimes have been moderately altered from their HRV due to long fire return intervals or the establishment of highly flammable, non-native species which increase fire occurrence and expand the HRV. Fires can have moderately negative impacts on species composition, soil conditions, and hydrological process (Example: sagebrush encroached by oak/pinyon-juniper where moderate levels of restoration treatments are required, such as combination of prescribed fire with mechanical/hand treatment.)

Condition Class 3 — Lands significantly outside their HRV where fires may significantly damage the ecosystem. Stand replacement fire events may damage soils, eliminate desired ecosystem components, and exacerbate the spread of unwanted non-native species, resulting in dramatically different ecological effects compared with reference conditions. (Example: ponderosa pine with a dense understory or sites dominated by cheat grass where intensive restoration treatments, such as mechanical treatments, seeding, herbicide, biomass removal, and other intensive treatments are required before fire can be used to restore desired ecosystem function.)

Because of the relatively short fire frequency in the shrublands north of I-70, this area would be classified as Fire Regime Group II. Aggressive fire suppression in the past 60 years has affected this area. The declining condition of the shrublands and evidence of some juniper encroachment indicate that the project area north of I-70 falls into Condition Class 2.

The lodgepole pine stands south of I-70, with a fire frequency of up to 300 years, are classified as Fire Regime Group V. Fire suppression has not significantly affected these lodgepole pine stands. Recent MPB activity will change stand dynamics over time, possibly for as long as 30 to 40 years. For now, the relatively low flammable condition of the stands south of I-70 has resulted in a Condition Class 1 designation.

Fuel Models within the Analysis Area

Fire modeling is conducted to assess the likely fire behavior under different environmental conditions. Fuel models are selected that represent the surface vegetation characteristics to be used as input to a computer fire behavior model. There are 13 described fuel models (Anderson 1982).

A particular type of fire will burn in the fuel type most likely to support it. Therefore, the selection of a fuel model is somewhat subjective. One fuel model may best represent the rate of spread while another may depict fire intensity more accurately. Selecting the appropriate fuel model requires the integration of knowledge and experience.

Of the 13 fuel models, seven were identified in the project area. Fuel Models 1, 2, 5, and 8 were identified north of I-70. Fuel Models 8, 10, 11, and 12 were identified south of I-70. These fuel models are described briefly below.

- **Fuel Model 1 (Short Grass)** north of I-70 is found in areas that have recently burned (1 to 20 years) or in open aspen stands. This fuel model has moderate flame length and the highest rate of spread of all the fuel models in the project area. Fire behavior under extreme 97-percentile weather is controllable by ground firefighting resources (especially fire engines) because of the relatively low fire intensity and high fire line production rate in this light fuel type. Fire line production rate represents the effectiveness of a firefighting resource to fight a wildland fire. Defending structures in the wildland urban interface is relatively easy because of the effectiveness of water on these light fuels.

- **Fuel Model 2 (Sagebrush/Grass)** north of I-70 is dominated by the sagebrush/grass/rabbitbrush type. This fuel model has a high rate of spread and the longest flame length of all the fuel models in the project area. Fire behavior under extreme 97-percentile weather creates very difficult conditions for ground firefighting resources controlling wildland fires in these fuels because of the high fire intensity, relatively high rate of spread, and moderate fireline production rate. Defending structures in the wildland urban interface would be the most difficult of all the fuel models north of I-70.

- **Fuel Model 5 (Low Shrubs)** north of I-70 is primarily made up of the serviceberry/mountain mahogany type. In this area, most of this model is found on steep, south-facing slopes with a high proportion of exposed ground. This fuel model has a moderate rate of spread and flame length. Fire behavior under extreme 97-percentile weather can make control by ground firefighting resources difficult because of high fire intensity, moderate rate of spread, and fireline production rate. The high proportion of exposed ground found locally in this fuel model would likely create fire conditions of low to moderate rates of spread and fire intensity. Normally, defending structures in the wildland urban interface would be fairly difficult in these fuels; however, because there is more exposed ground in the project area, structures could be more easily defended.

- **Fuel Model 8 (Short Needle Litter and Hardwood Litter)** is the predominant model in the lodgepole pine stands south of I-70 and in the aspen stand with a closed canopy north of I-70. This fuel model has the lowest rate of spread and flame length. Fire behavior under extreme 97-percentile weather is quite controllable by ground firefighting resources.

- **Fuel Model 10 (Heavy Dead Fuel)** – There is a moderate amount of this fuel type in the lodgepole pine stands. As MPB-killed trees fall and accumulate on the forest floor, some stands will start to move toward this fuel model. Fire behavior under the extreme 97-percentile weather makes control by ground firefighting resources difficult because of greater fire intensity and the slow fireline production rate in these heavy fuels.

- **Fuel Model 11 (Light Logging Slash)** – There is little of this fuel type in these lodgepole pine stands except in areas of light timber harvest or MPB control efforts. Fire behavior under the extreme 97-percentile weather makes control by ground firefighting resources more difficult than in Fuel Model 8, but not as difficult as in Fuel Model 10, because of greater fire intensity and relatively slow fireline production rate.

- **Fuel Model 12 (Moderate Logging Slash)** – There is little of this fuel type in the lodgepole pine stands except in area of recent moderate timber harvest or MPB control efforts with red slash. Fire behavior under the extreme 97-percentile weather makes control by ground firefighting resources very difficult because of very high fire intensity, relatively high rate of spread, and slow fireline production rate in these heavy fuels.

The number of acres within each fuel model is summarized for the project area in **Table 3–43**. These values were generated from a GIS fuel model layer for a broad area, and do not reflect the minor components identified previously.

Table 3–43 Fuel Models in the Project Area (in Acres)

Fuel Model	Typical Fuel Complex	Acres
1	Short Grass	9,280
2	Sagebrush/Grass	1,048
5	Low Shrub Understory	825
6	Shrubs	768
8	Hardwood / Short Needle Litter	29,248
10	Heavy Dead Fuel	14,658
Total		55,827[1]

[1] Total does not include 1,771 acres without a fuel model, such as rock outcrops or bodies of water.

Fire Weather

Historic weather data is a key input in fire modeling. For this project, weather data were obtained from the Dowds Junction Station from June 1 through October 1, for 1986 through 2003. The 97th percentile weather was used with predominant winds coming from the west, northwest, and north.

Fire Behavior

Fire behavior was modeled in the project area using FlamMap, a publicly available fire behavior mapping and analysis program. It computes potential fire behavior characteristics over a landscape. FlamMap uses constant weather and fuel moisture conditions to calculate fire behavior information such as rate of spread, flame length, and crown fire behavior. FlamMap is an ideal tool to compare relative fire behavior changes resulting from fuel modifications (Fire Sciences Lab 2004).

FlamMap uses several GIS layers to calculate fire behavior and fuel variables. Elevation, aspect and slope were generated from U.S. Geologic Survey digital elevation models, and cover type from the Forest

Service common vegetation unit database. A fuel model layer was created based on cover type. To capture treatment effects, aspen and lodgepole pine treatments were modeled using the FVS. Variables such as crown base height, crown bulk density, and canopy height were calculated for each alternative. A description of the FVS modeling is included in the *Project File*. These variables were combined with professional knowledge to develop customized treatment effects for the proposed treatment units. Outputs of analysis indicators for fire behavior are described below.

Flame length provides a quantitative measure of a fire's intensity and its resistance to control and suppression. Flame lengths, their resulting hazard rating, and fire suppression interpretation are provided in **Table 3–44**.

Table 3–44 Flame Length Hazard Rating

Flame Length (feet)	Hazard Rating	Fire Suppression Interpretation
Less than 4	Low	Fires can generally be attacked at the head or flanks by persons using hand tools. Handline should hold the fire.
5 to 8	Moderate	Fires are too intense for direct attack on the head by hand crews. Handline cannot be relied on to hold fire. Equipment such as dozers, engines, and aircraft retardant can be effective. Fires are potentially dangerous to personnel and equipment.
9 to 12	High	Fires may present serious control problems such as torching, crowning, and spotting. Control efforts at the head will probably be ineffective.
Greater than 12	Extreme	Crowning, spotting, and major fire runs are probable. Control efforts at the head of the fire are ineffective.

Flame lengths are a factor if a fire has the potential to transition into the canopy. Once a fire transitions into the canopy, fire suppression efforts become much more difficult. Current potential flame lengths in the proposed treatment units are shown in **Table 3–45**. Proposed treatment units are described in detail in **Appendix D**. As juniper encroaches, the likelihood of a crown fire increases in aspen, rabbitbrush, and sagebrush.

Table 3–45 Current Fire Behavior in the Proposed Treatment Units

Unit	Dominant Cover Type	Acres	Slope (percent)	Aspect	Fuel Model	Flame Length (feet)	Fire Behavior	Rate of Spread (chains/hour)
101	Lodgepole pine	33	40	N	8	0 - 2	Surface Fire	0 - 20
102	Lodgepole pine	40	36	NW	10	2 - 6	Surface Fire	0 - 20
103	Lodgepole pine	25	24	SE	8	0 - 2	Surface Fire	0 - 20
104	Lodgepole pine	42	24	SE	10	2 - 4	Surface Fire	0 - 20
105	Lodgepole pine	45	26	SE	8	0 - 2	Surface Fire	0 - 20
106	Lodgepole pine	26	30	SE	10	2 - 6	Surface Fire	0 - 20
115	Lodgepole pine	48	22	E	10	2 - 4	Surface Fire	0 - 20
116	Lodgepole pine	16	21	E	10	2 - 4	Surface Fire	0 - 20
117	Lodgepole pine	22	36	NW	8 and 10	0 - 6	Surface Fire	0 - 20
118	Lodgepole pine	127	28	NE	10	2 - 4	Surface Fire	0 - 20
119	Lodgepole pine	21	19	N	8 and 10	0 - 4	Surface Fire	0 - 20
120	Lodgepole pine	46	20	N	8 and 10	0 - 4	Surface Fire	0 - 20
121	Lodgepole pine	29	38	NW	8 and 10	0 - 6	Surface Fire	0 - 20

Unit	Dominant Cover Type	Acres	Slope (percent)	Aspect	Fuel Model	Flame Length (feet)	Fire Behavior	Rate of Spread (chains/hour)
122	Lodgepole pine	11	37	N	8 and 10	0 - 6	Surface Fire	0 - 20
123	Lodgepole pine	38	18	NE	8 and 10	0 - 4	Surface Fire	0 - 20
124	Lodgepole pine	15	20	NE	10	2 - 4	Surface Fire	0 - 20
125	Lodgepole pine	18	19	NE	10	2 - 4	Surface Fire	0 - 20
126	Lodgepole pine	10	21	E	8 and 10	0 - 4	Surface Fire	0 - 20
127	Lodgepole pine	18	25	E	8 and 10	2 - 4	Surface Fire	0 - 20
128	Lodgepole pine	39	22	N	10	2 - 4	Surface Fire	0 - 20
129	Lodgepole pine	27	31	N	8	0 - 2	Surface Fire	0 - 20
201	Aspen	71	38	NE	8	0 - 2	Surface Fire	0 - 20
202	Aspen	53	45	NE	8	0 - 6	Surface Fire	0 - 20
203	Aspen	30	40	NE	8 and 10	0 - 12	Surface and Passive Crown Fire	0 - 20
204	Aspen	10	28	N	8	0 - 2	Surface Fire	0 - 20
205	Aspen	6	38	NE	8	0 - 2	Surface Fire	0 - 20
206	Aspen	10	29	NE	8	0 - 2	Surface Fire	0 - 20
207	Aspen	19	43	NE	8	0 - 2	Surface Fire	0 - 20
208	Aspen	5	41	NE	8	0 - 2	Surface Fire	0 - 20
209	Aspen	6	40	NE	8	0 - 2	Surface Fire	0 - 20
301	Sagebrush	75	30	S	1 and 2	2 - 6	Surface Fire	0 - 60
302	Rabbitbrush	40	39	S	2	2 - >12	Surface and Active Crown Fire	0 - >60
303	Sagebrush	94	52	S	1, 2, and 8	2 - >12	Surface and Active Crown Fire	0 - >60
305	Aspen	116	46	S	2, 5, 8, and 10	0 - >12	Surface and Active Crown Fire	0 - >60
306	Aspen	119	43	S	1, 2, 5, and 8	0 - >12	Surface and Active Crown Fire	0 - >60
309	Serviceberry	64	52	S	6	0 - >12	Surface and Active Crown Fire	0 - >60
310	Grassland	72	39	S	1 and 2	0 - >12	Surface and Active Crown Fire	0 - >60
313	Aspen	325	45	N	1 and 8	0 - 6	Surface Fire	0 - >60
411	Aspen	123	44	SW	8	0 - 2	Surface and Active Crown Fire	0 - >60
412	Aspen	398	48	SW	1, 8, and 10	0 - 8	Surface Fire	0 - >60
514	Aspen	60	44	SW	6 and 8	0 - >12	Surface and Active Crown Fire	0 - >60
515	Aspen	171	48	SW	1 and 8	0 - 6	Surface Fire	0 - >60

Unit	Dominant Cover Type	Acres	Slope (percent)	Aspect	Fuel Model	Flame Length (feet)	Fire Behavior	Rate of Spread (chains/hour)
617	Aspen	39	47	SW	8	0 - 2	Surface Fire	0 - 20
618	Aspen	70	47	S	2 and 8	0 - >12	Surface and Active Crown Fire	0 - >60
619	Aspen	42	40	S	2 and 8	0 - >12	Surface Fire	0 - 60
620	Aspen	76	49	S	8	0 - 2	Surface Fire	0 - 20

Rate of spread indicates the relative activity of a fire spreading horizontally, expressed in chains per hour, with one chain equal to 66 feet. Rate of spread alone cannot fully describe a fire's behavior or indicate the likely success of suppression. Coupled with flame length, a more complete description of a fire can be gained. For example, an active crown fire may have a low rate of spread, but flame lengths in excess of 10 feet will make suppression difficult. Conversely, a fast moving grass fire with shorter flame lengths would be easier to contain. Current potential rates of spread in the proposed treatment units are shown in **Table 3–45**.

Crown fire behavior categorizes the type of fire likely to occur given current fuel conditions and weather. A surface fire will spread through duff and ground fuels. Short flame lengths and the absence of ladder fuels will likely inhibit the fire from reaching the canopy. A passive crown, or torching, fire occurs when small pockets of ladder fuels carry a surface fire to the canopy in localized areas. Individual trees or small groups of trees may ignite, but the fire advances primarily through surface fuels. An active crown fire occurs when surface fuels transition fire to the canopy, and the fire continues to advance through both the surface and the canopy. Wind speed, slope, and canopy density influence the rate of spread once an active crown fire ignites. Current crown fire behavior in the proposed treatment units are shown in **Table 3–45**.

Fire Occurrence

Unlike most western National Forest Ranger Districts, the Holy Cross Ranger District has a very low percentage of fires caused by lightning (24 percent). Seventy-six percent of all fires started between 1986 and 2000 on the district were human caused. All of the fires between 1987 and 2000 have occurred from June to October, with 35 percent occurring in July. The percentage of human-caused fires would indicate that a fire prevention program would be a cost effective way of reducing the wildland fire risk in the Vail Valley area.

Environmental Effects

Direct and Indirect Effects by Alternative

This section analyzes the effects of vegetation treatments as they relate to providing fuel for a wildland fire. The number of acres proposed for treatment under each action alternative is small relative to the entire project area. As a result, reduction in wildland fire hazards would be localized. However, all treatment units are located in the wildland urban interface, focusing the benefits of treatment in the important areas for fire prevention and hazard reduction.

Much of the project area is within inventoried roadless areas or designated wildernesses, limiting treatment options. The Eagles Nest and Ptarmigan Peak Guidebook for Wildland Fire Use allows for natural ignitions to be managed for resource benefit under certain conditions. Lands adjacent to the Town of Vail currently may require suppression due to the threat of wildland fire on adjacent property. In those areas without access restrictions, steep slopes further limit the area that can be reasonably treated to reduce hazards associated with wildland fire. Therefore, large areas will remain at their current fire hazard

following the implementation of any alternative. Should a high intensity crown fire occur in these areas, it is probable that large areas would burn, and fire suppression efforts would be limited.

Continued, and likely expanding, development and recreational use of the Vail Valley will perpetuate the occurrence of human-caused fires, the most common source of ignition in the project area. Public education and fire prevention programs would aim to reduce the frequency of human ignitions.

Alternative A – No Action

Under the No Action alternative, the fire and fuels conditions in the project area would remain unchanged. Because there would be no vegetation treatments in the project area, fuels buildup would continue, increasing fire hazard in the wildland urban interface. It is likely that recreational use will continue to expand in the project area, increasing the risk of human-caused fires.

Though the current fire hazard of the lodgepole pine units is not high, the 20-year modeling predictions show an increase in hazardous fire behavior. Areas likely to carry passive crown fires and 4- to 6-foot flame lengths both increase in size over time. Should the current MPB infestation further intensify and spread in the absence of treatment, areas with these potential fire conditions are likely to increase in size.

No aspen stands would be enhanced or maintained under Alternative A. The capacity of these stands to function as forested fuelbreaks would remain in their current condition and decline over time. Likewise, aspen patches within lodgepole pine units would not be treated, and their succession toward pine would continue, lessening their ability to act as fuelbreaks.

Alternative B

Though the primary focus of the lodgepole pine treatments is to reduce future MPB risk, they would also reduce the fire hazard in the area treated. Standing dead merchantable trees killed by MPB are adding to the fuel load, and would be removed. Trees declining in health, which would eventually die, would also be removed. Reducing fuels created by overstory mortality would reduce fire hazard in the area treated.

Fire behavior was analyzed across alternatives for the years 2014 and 2024. In **Table 3–45**, fire behavior is described as acres within the categories of none, surface fire, passive crown fire, or active crown fire. The proposed treatments would not dramatically alter fire behavior in lodgepole pine because they would not significantly affect the fuel models used as input data for fire behavior modeling. The only projected effect of the lodgepole pine treatments on fire behavior would be an increase in the acreage of passive crown fire in 2024. There also is a corresponding decrease in surface fire acreage in 2024. Regeneration following thinning, sanitation, and salvage could act as ladder fuels, aiding the transition of a surface fire to the canopy. Thinning or weeding to remove this ingrowth could be performed to reduce the hazards that could contribute to a passive crown fire. Treatments in lodgepole pine would not have any noticeable effect on flame length or rate of spread in 2014. There would be a measurable increase in acres with conditions supporting shorter flame lengths in 2024.

Aspen treatments in the Vail Intermountain area would enhance their function as forested fuelbreaks. Encroaching pines would be removed to encourage the persistence of aspen, a less fire-prone forest type. Pruning live limbs to 12 feet would decrease the likelihood that fire would reach the canopy. Maintaining the unroaded character of the area would not allow for the removal of the cut trees, and therefore they must be left on the ground. The potential effects of this increased fuel load would be reduced by removing limbs from cut trees and bucking the trees into shorter lengths to keep these added fuels close to the ground. These measures would reduce the vertical arrangement of the fuel profile. The majority of the CWD created by treatment would be greater than 3 inches in diameter and would not contribute to dangerous fire behavior. Model projections of aspen treatments do not show any measurable effect on surface fire behavior, flame length, or rate of spread.

Table 3–46 FlamMap Predicted Fire Behavior

Current Condition (2004)																
		Fire Behavior (Acres)				Flame Length (feet)						Rate of Spread (chains[1] per hour)			
Units	Potentially Affected Acres[2]	None	Surface Fire	Passive Crown Fire	Active Crown Fire	0-2	2-4	4-6	6-8	8-12	> 12	0-20	20-40	40-60	> 60
Lodgepole Pine	687	< 1	605	82	0	225	431	30	1	< 1	0	684	3	< 1	0
Aspen	320	8	311	1	0	284	24	11	1	< 1	0	320	< 1	< 1	< 1
Fuels	1,868	0	1,868	0	< 1	0	0	601	1,119	148	< 1	154	1,243	422	50

[1] One chain equals 66 feet.

[2] Potentially affected acres represent the locations of all treatment units considered for the VVFH project.

Projected Conditions																
			Fire Behavior (Acres)				Flame Length (feet)						Rate of Spread (chains[1] per hour)			
Alternative	Units	Potentially Affected Acres[2]	None	Surface Fire	Passive Crown Fire	Active Crown Fire	0-2	2-4	4-6	6-8	8-12	> 12	0-20	20-40	40-60	> 60
Year 2014																
Alternative A	Lodgepole Pine	687	< 1	571	116	0	221	211	247	7	< 1	0	684	3	< 1	0
	Aspen	320	8	311	1	0	284	9	24	3	< 1	< 1	319	< 1	< 1	< 1
	Fuels	1,868	0	1,868	0	< 1	0	0	601	1,119	148	< 1	154	1,243	422	50
Alternative B	Lodgepole Pine	687	< 1	571	117	0	221	211	241	3	0	0	684	3	< 1	0
	Aspen	320	8	311	1	0	284	9	25	3	< 1	0	320	< 1	< 1	< 1
	Fuels	1,868	0	1,868	0	0	0	0	1,096	722	50	0	0	28	35	1,806
Alternative C	Lodgepole Pine	687	Same as Alternative B				Same as Alternative B						Same as Alternative B			
	Aspen	320														
	Fuels	1,868					0	0	980	781	107	0	31	359	167	1,311

Projected Conditions																
			Fire Behavior (Acres)				Flame Length (feet)						Rate of Spread (chains[1] per hour)			
Alternative	Units	Potentially Affected Acres[2]	None	Surface Fire	Passive Crown Fire	Active Crown Fire	0-2	2-4	4-6	6-8	8-12	> 12	0-20	20-40	40-60	> 60
Alternative D	Lodgepole Pine	687	Same as Alternative B				Same as Alternative B						Same as Alternative B			
	Aspen	320					284	9	24	3	< 1	< 1				
	Fuels	1,868					0	0	900	839	130	0	31	482	253	1,102
Year 2024																
Alternative A	Lodgepole Pine	687	< 1	535	152	< 1	222	175	276	14	< 1	0	684	3	< 1	< 1
	Aspen	320	8	311	1	0	284	9	24	3	< 1	< 1	320	< 1	< 1	< 1
	Fuels	1,868	0	1,868	0	< 1	0	0	601	1,119	148	< 1	154	1,243	422	50
Alternative B	Lodgepole Pine	687	< 1	484	203	0	221	189	270	7	< 1	< 1	684	3	< 1	0
	Aspen	320	8	311	1	0	284	9	25	3	< 1	0	320	< 1	< 1	< 1
	Fuels	1,868	0	1,868	0	0	0	0	1,040	757	72	0	0	85	48	1,735
Alternative C	Lodgepole Pine	687	Same as Alternative B				Same as Alternative B						Same as Alternative B			
	Aspen	320														
	Fuels	1,868					0	0	923	816	129	< 1	31	416	181	1,241
Alternative D	Lodgepole Pine	687	Same as Alternative B				Same as Alternative B						Same as Alternative B			
	Aspen	320														
	Fuels	1,868					0	0	843	874	150	0	31	539	267	1,032

[1] One chain equals 66 feet.

[2] Potentially affected acres represent locations of all treatment units considered for the VVFH project.

Objectives for the fuel treatment units would be accomplished with broadcast burning, mechanical fuel reduction, pile burning, or a combination of methods. In all cases, existing fuel loads would be reduced. Most of these units are categorized as Fuel Model 2, and would be changed to a mix of Fuel Models 1 and 8 (**Appendix D**). According to model projections, the proposed treatments would alter fire behavior in the fuels treatment units by reducing flame lengths. Alternative B would move more acres to conditions supporting shorter flame lengths and higher rates of spread in both 2014 and 2024 than Alternative A, the No Action alternative. The large areas of high rates of spread reflect fire behavior in the grass-dominated fuel types expected to regenerate following the fuel reduction treatments. Shrubs and trees that provided sheltering and wind interruption, slowing an advancing fire, would be removed, thus increasing the potential rate of spread. These conditions are more favorable to fire suppression than slower rates of spread in shrubs and trees. This treatment would also contribute to a decrease in the hazards associated with a wildland fire escaping from a designated wilderness. Broadcast burning would increase the opportunities to allow fire to play its more natural role in designated wilderness by decreasing the hazards outside of wilderness.

Because the number of acres proposed for treatment under Alternatives B, C, and D is small relative to the project area, the location of treatment units in the wildland urban interface focuses the benefits for hazard reduction. Alternatives B, C, and D each provide some measure of hazard reduction in the wildland urban interface. **Table 3–47** summarizes the acreage that each alternative provides for fuelbreaks in the wildland urban interface. Acres shown in **Table 3–47** are based on estimated sizes of the proposed treatment units, and may not match the summary of project activities in **Table 2–2**, acre for acre. The Forest Service expects up to a 15 percent variation between the acres planned for treatment and the acres treated, based on site-specific vegetation data and project design.

Table 3–47 Fuel Reduction in the Wildland Urban Interface (Acres)

Cover Type	Alternative A	Alternative B	Alternative C	Alternative D
Aspen	0	1,539	1,018	802
Grass and Shrublands	0	345	345	345
Total[1]	0	1,884	1,363	1,147

[1] Values are rounded in Table 2-2

The results of the FlamMap modeling are shown in **Table 3–46** for 2014 and 2024. Alternatives C and D would treat fewer acres than Alternative B. To facilitate the comparison of alternatives, the potentially affected acres shown in **Table 3–46** represents the locations of all treatment units considered for the VVFH project under any action alternative.

In lodgepole pine and aspen units, the proposed project would not dramatically alter fire behavior, flame length, or rate of spread from the current condition. This does not indicate a lack of success from a treatment standpoint, but rather the influence of two factors controlling general fire behavior. First, these units do not currently present a high hazard in the variables analyzed. The majority of the acreage in these two cover types would carry surface fires with flame lengths less than 4 feet, moving less than 20 chains per hour. Secondly, the treatment designs for lodgepole pine and aspen would not sufficiently change the vegetation structure to influence fire behavior. To realize such changes, the treatments would have to convert a unit into a different fuel model. This could be accomplished by either removing a significant portion of the trees creating a grass-dominated fuel model, leaving a larger portion of logging slash on site, or other treatment variations. Following many of these treatments, scenic integrity objectives of the project area would be compromised and higher fire hazard conditions would be created. Since the purpose and need of the project can be met without such treatments, not altering fire behavior in the lodgepole pine was an anticipated outcome. However, these model results indicate that predicted fire behavior

would not be made worse by the treatments. Areas treated with sanitation and salvage will still be categorized as a forested fuel model, as sufficient tree density and cover will remain. The same design criteria will be applied to sanitation and salvage treatments, so post-harvest levels of woody debris and logging slash will be within acceptable limits. The cone-bearing tops of some infested trees removed by sanitation would be left in the unit to provide seed sources for lodgepole pine regeneration. These tops would be scattered throughout the unit, and would not appreciably add to the fuel load. Fuels treatments would create a barrier to crown fire, a result not measurable in fire behavior modeling.

Alternative B would reduce the hazard of a wildland fire in the Vail Valley wildland urban interface. This alternative would treat the largest acreage of fuel treatment units, approximately 1,900 acres. The treatment of all proposed fuel reduction units would best address the desire to lessen the impacts of wildland fire in the project area. **Table 3–47** displays the acres of fuel reduction for the proposed action. In all aspen units in the Vail Intermountain area as well as aspen patch cuts near Minturn, lodgepole pine would be thinned to stimulate aspen suckering and enhance forested fuelbreaks.

Modeling of fire behavior shows the positive effects of fuel reduction persist for at least 20 years (**Table 3–46**). In particular, treatments would support shorter flame lengths in a larger area for both 2014 and 2024 than the other action alternatives. These predictions assume that natural recovery would occur following treatments. Additional treatments or the occurrence of wildland fire would alter the predictions.

Broadcast burning in Eagles Nest Wilderness would decrease the wildland fire hazard to property adjacent to this wilderness and increase the opportunities to allow natural ignitions to be managed for resource benefits.

Alternative C

The effects of Alternative C would be the same as Alternative B, with the following exceptions. Units 411 and 412 in the Eagles Nest Wilderness would be dropped, decreasing the acreage treated for fuel reduction by about 520 acres. The remaining fuel units would be treated with mechanical thinning and pile burning rather than broadcast burning. The larger proportion of fuel treatment areas in flame lengths over 6 feet is a result of the omission of Units 411 and 412, and not from the treatment method. In the units treated, Alternative C would have the same effect on reducing hazardous fire behavior as Alternative B, but would require more time to complete and at a higher expense.

Alternative D

The effects of Alternative D are the same as Alternative B, with the following exceptions. To address concerns of cutting trees in inventoried roadless areas, several units would be dropped from the proposed action. Unit 202 would be the only aspen unit treated in the Vail Intermountain area. The omitted aspen units would continue on the successional pathway of converting to pine, losing their function as fuelbreaks. Fuel treatment units 412, 515, and 620 also would be dropped. Units 618 and 619 would be reduced in size to 12 and 8 acres, respectively. These omitted units would leave approximately 737 acres in their current condition.

Cumulative Effects by Alternative

Alternative A – No Action

Under Alternative A, the cumulative effects of fire suppression in the Vail Valley would continue to increase wildland fire hazards in the project area. The mortality of lodgepole pine from MPB infestation would also increase wildland fire hazards and fuels buildup in an expanding area as infested trees die and fall over time.

Current fire suppression efforts outside designated wilderness would continue. Within the Eagles Nest Wilderness, under certain conditions natural ignitions would be managed for resource benefits and would be allowed to play a more natural role. Though many past projects focused on sanitation and salvage in areas of insect and disease outbreaks, a secondary benefit of these projects was to reduce the fire hazards associated with outbreak mortality.

Alternative B

Under Alternative B, fire suppression in the Vail Valley would continue outside designated wildernesses. Within the Eagles Nest Wilderness, under certain conditions natural ignitions would be managed for resource benefits and would be allowed to play a more natural role.

Untreated lodgepole pine would continue to mature over time. The mortality of lodgepole pine from MPB infestation would increase wildland fire hazards by a buildup of fuels as infested trees die and fall over time. In treated stands, lodgepole pine seedlings and saplings would create ladder fuels and increase wildland fire hazards after 10 years. Past and future projects focused on sanitation and salvage in areas of insect and disease outbreaks would contribute to the improvement of forest health and the reduction of wildland fire hazards associated with outbreak mortality. The VVFH Project would address reducing future MPB risk and reducing hazardous fuels, improving overall forest heath in the project area.

Alternative C

The cumulative effects for Alternative C would not be expected to vary from those described above for Alternative B.

Alternative D

The cumulative effects for Alternative D would not be expected to vary from those described above for Alternative B.

Forest Plan Consistency

The action alternatives are consistent with Forest Plan direction to protect, maintain, and enhance forest resources through fire protection and the use of prescribed fire. Because forest-wide objectives and strategies place a high priority on fuel reduction in the wildland urban interface, the action alternatives are an important aspect of fire and fuel management activities on the Forest.

Irreversible and Irretrievable Commitments

No irreversible or irretrievable commitments of forest vegetation would result from the implementation of treatments in the project area. Trees, grasslands, and shrublands are renewable resources allowing flexible management strategies designed to meet changing conditions. Any resources removed or altered by implementing the project would be recuperated naturally in the timeframe of forest and non-forest vegetation growth.

3.3.4 Wildlife

Resource Description

Wildlife and preferred wildlife habitats are influenced by vegetation composition, structure, spatial management, recreational use of roads and trails, and management activities. Project activities have the potential to affect wildlife through injury, mortality, disturbance, or alteration of suitable habitat. Changes in habitat capability create an additional potential issue unique to Management Indicator Species (MIS).

Indicators

- Effects on Federally Listed Species
    - Effects on suitability of lynx habitats
    - Effects on lynx denning habitats
    - Changes in winter snow compaction in lynx habitats (acres)
    - Determinations of effect for proposed, threatened, and endangered species
    - Compliance with appropriate Forest Plan standards

- Effects on Forest Service Sensitive Species
    - Effects on Forest Service sensitive species
    - Determinations of effect for Forest Service sensitive species
    - Compliance with appropriate Forest Plan standards

- Effects on Management Indicator Species (MIS)
    - Effects on habitat capability for MIS
    - Effects on MIS
    - Compliance with appropriate Forest Plan standards and MA guidance

- Effects on Species of Concern
    - Effects on species of concern
    - Compliance with Forest Plan MA guidance

- Effects on Species of Viability Concern

Forest Plan Direction

Overall management direction includes the following national strategic goals: protecting ecosystem diversity and productivity by maintaining viable populations of all native and desired non-native wildlife in habitats throughout their geographic range; producing habitat capability levels to meet objectives for MIS; providing diverse opportunities for use of wildlife resources in accordance with local demands; developing and implementing management objectives for sensitive species, ensuring that species do not become threatened or endangered because of Forest Service actions; and managing habitats and activities for threatened and endangered species to achieve recovery objectives (Forest Plan, pages AA-4, AA-14, and AA-16). This guidance is further emphasized in the regional goal of providing for a variety of life through management of biologically diverse ecosystems (Forest Plan, page 1-1).

Forest-wide goals, objectives, and strategies for wildlife resources include promoting ecosystem health and conservation to sustain viable populations, achieve MIS objectives, implement strategies to conserve

and recover, as appropriate, all special status species on the WRNF (Forest Plan, pages 1-3 to 1-8); emphasizing wildlife management activities within wilderness that assure the protection of natural processes and conform with the Wilderness Act (Forest Plan, page 1-11); and cooperating with CDOW to achieve desired population objectives (Forest Plan, page 1-12). Species addressed include federally listed threatened or endangered species, proposed and candidate species, sensitive species, MIS, species of viability concern, species of concern, and species that require more data to determine their status. Positive trends in habitat availability, habitat quality, or other factors affecting sensitive species or MIS will be demonstrated within 15 years (Forest Plan, page 1-4). Broad-scale assessments will be created to provide information for projects in lynx habitat. Land management practices will address the use of management activities to retain or restore denning habitat in areas with the highest probability of escaping stand-replacing fire events, develop characteristics suitable for lynx and snowshoe hare habitat, or promote the regeneration of snowshoe hare habitat (Forest Plan, pages 1-4 and 1-5).

Key forest-wide standards and guidelines that apply to wildlife (Forest Plan, page 2-17 to 2-28) apply to all areas of the WRNF and include: applying seasonal restrictions to reduce disturbance in key habitats; protecting known active and inactive raptor nest areas; managing vegetative cover in riparian areas to provide suitable wildlife habitat along a minimum of 80 percent of the riparian zone; designing structures considering wildlife movement; managing for snowshoe hares as a prey source for Canada lynx; and ensuring that vegetation treatments and new roads and trails do not reduce elk habitat effectiveness index below 0.45 by DAU or further reduce effective habitat in DAUs that are already at or below 0.40 on NFS lands. Forest-wide standards and guidelines for silviculture (Forest Plan, pages 2-11 to 2-16) also affect wildlife habitat. Guidance in managing the size and location of openings and uncut areas created through vegetation management benefits wildlife habitat. The consideration of when artificial openings are no longer considered openings also affects the management of wildlife habitat.

Guidelines for MA 5.4 specify that travelways open to motorized travel will not exceed an average travelway density of two miles per square mile.

Forest Plan standards in MA 5.41 require vegetation composition and structure to be managed to meet the needs of deer, elk, and other species on their winter ranges, within the constraints of the conservation of biological diversity and the maintenance and enhancement of sensitive habitats. All new roads passing through MA 5.41 must avoid important forage, cover, and birthing areas. Vegetation management in MA 5.41 must be designed to maintain or improve deer and elk habitat objectives.

Forest Plan standards in MA 5.43 require vegetation management to be designed to maintain or improve elk habitat. Guidelines for MA 5.43 specify that travelways open to motorized travel will not exceed an average travelway density of one-half mile per square mile during seasonal periods when the area is designated for calving, migration, winter, or summer habitat. Other guidelines in MA 5.43 include providing adequate forage to sustain elk populations, and avoiding project-related activities in calving areas from May 15 to June 20.

Desired Condition

The overall desired condition for the Forest is to provide suitable biological and abiotic conditions that support viable populations of native, desired non-native, and protected wildlife species. The purpose of the proposed project is to reduce the likelihood of a large-scale crown fire and future MPB outbreaks. Reducing the potential for these events is expected to support the desired condition of the project area and Forest.

Temporal Scope

This analysis considers existing conditions and projected conditions immediately following implementation of the proposed treatments, and includes impacts for the duration of proposed activities. As time passes following implementation of the proposed treatments, the magnitude and intensity of effects on wildlife would decline as human activities related to project activities end, reclamation of disturbed areas is completed, and changes to treatment units lessen.

Geographic Scope

The area analyzed for wildlife is the project area, focusing on treatment units, however some wildlife species are managed within unique management units. The Canada lynx is managed within lynx analysis units (LAUs). There are four LAUs within the project area: Eagle Valley, Holy Cross, Camp Hale, and Brush Creek. Potential effects to the lynx, its habitats, and prey will be assessed within these LAUs. CDOW manages elk and deer populations within DAUs. DAUs are determined by an arbitrary boundary based on studies that show limited interchange between population segments of a species. Within the project area, there are portions of two elk DAUs: DAU 12 and DAU 16. The project area is located within a portion of deer DAU 8. Additionally, the Forest has designated MAs 5.41 (Deer and Elk Winter Range), 5.42 (Bighorn Sheep Habitat), and 5.43 (Elk Habitat) for managing habitats to support deer, elk, and bighorn sheep. MA 5.41 areas are located northeast of Avon, northeast of Minturn between the Eagle River and the Vail ski area boundary, and north of I-70 near the confluence of Gore Creek with the Eagle River. MA5.42 is located between the I-70 corridor and Spraddle Creek. MA#5.43 is located in the Stone and Whiskey Creek areas and in the vicinity of the Meadow Mountain A inventoried roadless area. Potential effects to these management areas within the project area will be assessed. Landscape-level conditions outside treatment units are described to place the project in context.

Affected Environment

This section provides a brief overview of federally listed species, Forest Service sensitive species, MIS, species of concern, and species of viability concern that may occur within the project area. A more detailed presentation of species selection, description, and analysis may be found in the Final Biological Assessment, Biological Evaluation, and Biologist's Report. These reports are in the *Project File* at the Holy Cross Ranger District Office in Minturn, Colorado.

Federally Listed Wildlife Species

The Canada lynx is the only federally listed species that may be affected by the proposed project. The lynx was listed as threatened by the United States Fish and Wildlife Service (FWS) in March 2000 (FWS 2000).

In Colorado, lynx habitat typically occurs in the subalpine and upper montane forest zones, between 8,000 and 12,000 feet in elevation. Upper elevation subalpine forests are dominated by subalpine fir and Engelmann spruce. As the subalpine zone transitions down to the upper montane, spruce-fir forests begin to give way to a predominance of lodgepole pine, aspen, or mixed stands. Engelmann spruce or subalpine fir may retain dominance on cooler, more mesic mid-elevation sites, intermixed with aspen, lodgepole pine, and Douglas-fir. In summary, lynx habitat should be considered in terms of a habitat mosaic within these southern boreal forest landscapes, rather than as simple vegetation types. Spruce/fir, lodgepole pine, white fir, aspen, and mesic Douglas-fir may all provide foraging or denning habitat for lynx. Denning females typically select habitats within these forested zones that are mature, dense, and contain a large component of down woody debris.

The snowshoe hare is an important prey species to the lynx, accounting for the majority of its winter diet. Snowshoe hares rely on foliage, twigs, and grasses during summer months and mostly needles, browse, and bark during the winter months. Hares are common in early seral stage forests associated with insular patches of shrubby and grassy areas in the summer and later seral stage forests of Douglas-fir, subalpine fir, and spruce during the winter months.

Also potentially important in many parts of the lynx range in Colorado are the high elevation sagebrush and mountain shrub communities found adjacent to or intermixed with forested communities, affording potentially important alternate prey resources. Riparian and wetland shrub communities (e.g. willow, alder, serviceberry) found in valleys, drainages, wet meadows, and moist timberline locations may also support important prey resources.

As part of a reintroduction effort initiated in 1999, the CDOW released 129 adult lynx into the southern and central mountain regions of the state. Since then, several lynx sightings have been reported in the vicinity of the Vail Valley. Winter track surveys and lynx hair snare surveys conducted in the Vail area by the Forest Service as part of the CATIII BO monitoring have not produced any evidence of lynx in the area to date (USFS 2000a). **Table 3–48** summarizes the acres of lynx habitats occurring within each of four affected lynx analysis units (LAUs).

Table 3–48 Lynx Habitats by Lynx Analysis Unit (Acres)

Lynx Habitats[1]	Lynx Analysis Units				Total Habitat
	Eagle Valley	Holy Cross	Camp Hale	Brush Creek	
Denning	14,244	17,006	7,604	21,112	59,966
Winter	18,894	13,626	19,746	12,918	65,184
Unsuitable	4,938	592	1,229	6,361	13,120
Non Habitat	42,031	35,365	21,234	33,072	131,702
Other	17,535	28,711	10,073	14,923	71,242
Total[1]	97,644	95,300	59,886	88,388	341,210

[1] Totals do not include acreage for privately owned lands within each LAU. LAUs extend outside the project area boundary.

Table 3–49 summarizes the acreages of lynx habitats on NF administered lands within the LAUs.

Table 3–49 Lynx Habitats within the Project Area (Acres)

Lynx Habitats[1]	Lynx Analysis Units				Total NFS
	Eagle Valley	Holy Cross	Camp Hale	Brush Creek	
Denning	6,378	2,210	321	12	8,921
Winter	13,767	1,162	501	<1	15,430
Unsuitable	2,335	136	183	0	2,654
Non Habitat	16,374	1,958	1,904	23	20,259
Other	8,361	648	931	7	9,947
Project Area Total	47,215	6,114	3,840	42	57,211[2]

[1] Source: January 2002 mapping

[2] Total does not include approximately 15,000 acres of non-Forest Service administered land within the project area.

Forest Service biology staff have been conducting a broad scale lynx habitat assessment of primarily lodgepole pine habitat within the Holy Cross and Dillon Ranger Districts, which includes the project area south of I-70. Initial results from these evaluations indicate that areas characterized as denning habitat by the Lynx Conservation Assessment Strategy (LCAS) do not meet the requirements for such habitat, as defined by the LCAS. Within the project area, this assessment indicated that there is a lack of suitable lodgepole pine stands that provide sufficient downed woody debris to support lynx denning. Understory vegetation in the lodgepole pine stands is non-existent or insufficient to support snowshoe hare during winter.

Lynx Linkage Areas – Linkage areas are areas of movement opportunities. They exist on the landscape and can be maintained or lost by management activities or developments. They are not "corridors" which imply only travel routes, they are broad areas of habitat where animals can find food, shelter and security. Dowds Junction and Vail Pass are the only two lynx linkage areas that occur within the project area.

Dowds Junction is west of Vail, and is a north-south connection with an existing underpass and fencing. At Dowds Junction, there is an intersection of highway and interstate, with two drainages intersecting as well. The CDOW has identified it as a major problem area for elk. Some data has been collected on animal use with cameras. It is also an important crossing area for deer, elk, and mountain lion. There is residential and commercial development on both the north and south sides of this linkage area.

Vail Pass linkage area provides movement areas from approximately Timber Creek to Guller Creek. The area crosses I-70 and has high winter recreation use. The area mapped for this linkage area is the best remaining place for animals to cross I-70 in the Vail area, based on terrain features, habitat, and lack of development. There is a potential to develop underpasses, as there is only one currently in place under westbound lanes.

Forest Service Sensitive Species

There are 33 sensitive wildlife species designated for the WRNF (USFS 2003c). The Final Biological Evaluation, on record for this project, presents a complete analysis of potential effects of the proposed project on sensitive species and determinations for each analyzed species. Sensitive wildlife species selected for analysis based on their known or potential occurrence in the project area include: American marten, pygmy shrew, northern goshawk, American peregrine falcon, boreal owl, American three-toed woodpecker, olive-sided flycatcher, sage sparrow, Brewer's sparrow, and boreal toad.

Although boreal toad may occur in Stone Creek, West Grouse Creek, and Grouse Creek, chorus frogs were the only amphibian species observed within the project area during surveys conducted in 2002. No Forest Service Sensitive amphibians (boreal toad, leopard frog) were observed in the project area, although there is suitable habitat. The nearest known boreal toad breeding site is located approximately 14 miles from the project area.

Management Indicator Species

Management Indicator Species (MIS) are species whose response to land management activities can be used to predict the likely response of a wide range of species with similar habitat requirements. There are 12 wildlife species and one general classification designated as MIS for the WRNF (Forest Plan, page EE-3). The Final Biologist's Report provides justification for species selection and a complete analysis of potential effects on selected species. MIS selected for analysis include the elk, snowshoe hare, and MacGillivray's warbler based on the potential to affect individuals of these species or their habitats. These species were selected and analyzed in accordance with the Region 2 Management Indicator Species "Checklist" for Decision-makers (Phinney 2004).

Habitat capability is defined as the ability of a specific land unit to support species of wildlife based on specific vegetative characteristics and local road densities. Habitat diversity (vegetation cover types and structural stages) and habitat effectiveness (road density) are assessed in the calculation of habitat capability. HABCAP, a modeling program, was used to assess potential changes to habitat capability.

Elk

Elk was selected as an MIS for this project based on the potential for the project to reduce habitat capability of elk ranges within the project area. CDOW manages big game ungulate herds in the state by DAUs. Two elk DAUs (DAU 12 Piney River and DAU 16 Frying Pan) occur within the project area. CDOW establishes population objectives for each DAU. Draft objectives were developed by CDOW in 2002 for elk in DAUs 12 and 16. The draft objective for DAU 12 is 2,950 individuals and the draft objective for DAU 16 is 5,100 individuals. Based on population estimates from 2001, elk populations within each of these DAUs are considerably higher than the objectives (population estimates for DAU 12: 7,000 and DAU 16: 7,900). The general population for this species across the state is higher than CDOW objectives. The general population trend for this species across the Forest is increasing.

The Forest Service has established a standard of 0.45 for the habitat effectiveness index for elk. The standard is applied at the DAU level. If the existing conditions within these DAUs are below 0.45, then the proposed project should not contribute to any further decrease in habitat effectiveness. The current habitat effectiveness index for existing elk summer range in DAU 12 is 0.473; the current habitat effectiveness index in DAU 16 is 0.385.

Snowshoe Hare

The snowshoe hare was selected as an MIS for this project based on the potential for the proposed project to affect Canada lynx habitat. In addition to being an indicator species for early seral habitats, the hare is also an important prey species for the Canada lynx and changes in its abundance can impact lynx populations (Ruggiero et al. 1999).

There are approximately 9,700 acres of early seral lodgepole pine and aspen that provide suitable summer foraging habitat in the project area. Winter foraging habitats on the Forest are typically late-successional conifer habitats. There are nearly 21,000 acres of late-successional spruce/fir and lodgepole pine in the project area. The current trend for these habitats types is considered stable. The population trend in Colorado is thought to be relatively stable, which is expected to be the same for the Forest.

In 1998 CDOW undertook an extensive statewide snowshoe hare pellet count survey to help identify areas for the reintroduction of lynx (Bartmann and Byrne 2001). The study suggested that the WRNF was near the statewide average for hare densities on national forests in Colorado. Preliminary investigations of snowshoe hare habitat and populations within the project area have been implemented as part of the ongoing Broad Scale Lynx Habitat Assessment. Results from these efforts will be compared with an expected minimum density of 0.5 hares/hectare necessary to support lynx populations (Ruggiero et al. 1999).

MacGillivray's Warbler

MacGillivray's warbler was selected as an MIS for this project to assess how the proposed treatments would impact species dependent on dense shrub habitats. Breeding grounds for MacGillivray's warbler are found from the base of the foothills to 9,000 feet in elevation. Dense shrub communities provide important foraging and ground nesting habitat for this species. Although this species typically occurs in oak brush, it will nest and forage in suitable sagebrush communities. The current trend for habitat throughout its range and on the Forest is unknown because little monitoring has occurred in these vegetation types. Population trends for the species throughout its range are unknown, though it may be

decreasing in some portions and increasing in others. The trend in Colorado may be decreasing (Carter 1998). The trend on the WRNF is unknown. The primary risk factor to this species includes actions that may reduce the density of suitable nesting and foraging shrub habitats.

Species of Concern

The Forest Plan lists three wildlife species of special concern: mule deer, bighorn sheep, and peregrine falcon. Included within the project area are 5,217 acres of deer management prescription (MA 5.41) and 1,012 acres of bighorn management prescription (MA 5.42). Mule deer and bighorn sheep are known to occur in suitable habitats within the project area. Although the peregrine falcon is known to nest in the WRNF and within the Holy Cross District, no nests are known to occur on Forest Service lands within the project area.

Species of Viability Concern

There are ten wildlife species designated as species of viability concern for the WRNF (Forest Plan, page EE-4). The Final Biologist's Report provides justification for species selection and a complete analysis of potential effects on selected species. Species of viability concern selected for analysis under other sections include Brewer's sparrow (Forest Service sensitive species), Canada lynx (federally listed species), and the boreal toad (Forest Service sensitive species).

Species Needing More Baseline Inventory or Evaluation

There are 15 species identified as needing more baseline inventory or evaluation on the WRNF (Forest Plan, page EE-6). None of these species are expected to occur in the project area. Consequently, this category of species is not addressed further.

Environmental Effects

Direct and Indirect Effects by Alternative

Effects to wildlife resources are organized by protective status (federally listed, sensitive, MIS, species of concern, and species of viability of concern). Where applicable, effects between the action alternatives are compared in tables. The complete description of species selection and analysis of effects, complete evaluations, and associated determination statements are provided in the Biological Assessment (BA) and Biological Evaluation (BE). The BA/BE is included in the *Project File*.

As is typically included in analysis of effects to wildlife, the following analyses include a presentation of the number of acres of suitable habitat that would be disturbed under each action alternative for each species. These treatment acres were generated using geographical information system (GIS) technology and represent the maximum extent of each treatment. Actual implementation of each treatment may vary in position and intensity within the generated polygon. Although variation between the implemented treatment and the GIS generated treatment polygon may fluctuate as much as 15 percent, the following analyses were based on the conservative estimates of maximum disturbance and do not underestimate habitat effects to wildlife.

Alternative A – No Action

Under the No Action alternative, there would be no effect on the Canada lynx, the only federally listed terrestrial species addressed in this analysis. Because no new roads or trails would be constructed or improved, there would be no related increase in the amount of snow compaction within the project area.

The determination is that implementation of the No Action alternative would have no effect on the Canada lynx.

Under the No Action alternative, no timber or fuel treatments would occur within the project area. Therefore, there would be no direct effects to Forest Service sensitive species. Under this scenario, ongoing Forest-wide management actions and the gradual maturation of forested habitats may continue to provide suitable habitats for Forest Service sensitive species. However, if untreated, forested habitats in the project area likely would become increasingly susceptible to insect outbreaks and large-scale crown fires. For the American three-toed woodpecker and the olive-sided flycatcher, these events may have beneficial effects. These species rely on tree-boring insects and occur in habitats that have been infected by insects or burned.

Under the No Action alternative, no timber or fuel treatments would occur within the project area. Therefore, there would be no direct effects to any MIS species or Forest Service species of concern. There are no additional effects specific to any action alternative other than those discussed under Effects Common to Action Alternatives.

Alternative B

Federally Listed Species

The determinations in the Biological Assessment prepared as part of Section 7 ESA consultation found "No Effect" on all terrestrial listed species except Canada lynx. Therefore, Canada lynx is the only federally listed terrestrial species to be addressed in this assessment. The following sections provide an analysis of the potential effects to suitability of lynx habitats, analysis of effects on lynx denning habitats, analysis of potential changes in snow compaction in lynx habitats, a determination of effect, and assessment of compliance with appropriate Forest Plan standards. There would be no effect on other federally-listed species, therefore other federally-listed species are not considered further in this analysis.

Canada Lynx

Project implementation would alter the availability and condition of existing vegetation and downed woody debris in some lynx habitats. Alternative B would not affect more than 2 percent of lynx denning and winter habitats within each LAU. Currently, much less than 30 percent of lynx habitats in the affected LAUs are in unsuitable condition. This effect on suitable lynx habitats also would be well below the 15 percent threshold for change to unsuitable habitat over a 10-year period established by the LCAS and adopted as a standard in the 2002 White River Forest Plan.

Using habitat characterization data developed using WRNF vegetation data, LCAS habitat parameters, and GIS analysis techniques, disturbance to lynx denning habitats under Alternatives B, C, and D was calculated for each affected LAU (**Table 3–50** through **Table 3–53**). In the Eagle Valley LAU, proposed disturbance to lynx denning habitats would affect less than 1 percent of the existing denning habitat in the LAU. In the Holy Cross LAU, proposed activities would disturb less than 2 percent of the available denning habitat in the LAU. No denning habitat would be disturbed by Alternative B in the Camp Hale LAU. The disturbed acreage in each LAU would be well below the 10 percent threshold for disturbance to existing denning habitat established by the LCAS and adopted in the Forest Plan. There are no proposed treatment units in the Brush Creek and Ten Mile LAUs. When analyzed across the project area, 2 percent of the available denning habitat would be disturbed under Alternative B.

Recent Forest Service field studies documented in the *Project File* indicate that the data in the Lynx Habitat GIS layer may not have been correctly characterized for the lodgepole pine forest type over much

of the Holy Cross Ranger District, including the project area. Data collected during these more specific field studies indicate that much of the denning habitat that is mapped in the project area and surrounding LAUs lacks appropriate understory cover and downed woody debris to qualify as suitable denning habitat. Even considering the habitat characterization as mapped, the acres that would be disturbed do not exceed established thresholds for various lynx habitats. The apparent discrepancy between mapped habitat characterizations and more recent field study results are not an issue.

Table 3–50 Lynx Habitats Affected in Eagle Valley LAU

Lynx Habitats[1]	Potential Disturbance (Acres)				Total Habitat[1] (acres)
	Alternative A	Alternative B	Alternative C	Alternative D	
Denning	0	185 (1%)[2]	185 (1%)[2]	153 (<1%)[2]	14,244
Winter	0	336 (1%)[2]	273 (1%)[2]	127 (<1%)[2]	18,894
Unsuitable	0	0	0	0	4,938
Non Habitat	0	1,139 (2%)[2]	832 (2%)[2]	688 (1%)[2]	42,031
Other	0	569 (3%)[2]	419 (2%)[2]	359 (2%)[2]	17,535
Total[1]	0	2,229 (<1%)[2]	1,709 (<1%)[2]	1,327 (<1%)[2]	97,644

[1]Total NFS acres in a lynx habitat category
[2]Values in parentheses represent percentage of NFS acres in the LAU that would be affected.

Table 3–51 Lynx Habitats Affected in Holy Cross LAU

Lynx Habitats[1]	Potential Disturbance (Acres)				Total Habitat[1] (acres)
	Alternative A	Alternative B	Alternative C	Alternative D	
Denning	0	348 (2%)[2]	348 (2%)[2]	348 (2%)[2]	17,006
Winter	0	29 (<1%)[2]	29 (<1%)[2]	29 (<1%)[2]	13,626
Unsuitable	0	26 (4%)[2]	26 (4%)[2]	26 (4%)[2]	592
Non Habitat	0	3 (<1%)[2]	3 (<1%)[2]	3 (<1%)[2]	35,365
Other	0	79 (<1%)[2]	79 (<1%)[2]	79 (<1%)[2]	28,711
Total[1]	0	485 (<1%)[2]	485 (<1%)[2]	485 (<1%)[2]	95,300

[1]Total NFS acres in a lynx habitat category
[2]Values in parentheses represent percentage of NFS acres in the LAU that would be affected.

Table 3–52 Lynx Habitats Affected in Camp Hale LAU

Lynx Habitats[1]	Potential Disturbance (Acres)				Total Habitat[1] (acres)
	Alternative A	Alternative B	Alternative C	Alternative D	
Denning	0	0	0	0	7,604
Winter	0	0	0	0	19,746
Unsuitable	0	0	0	0	1,229
Non Habitat	0	325 (2%)[2]	325 (2%)[2]	325 (2%)[2]	21,234
Other	0	0	0	0	10,073
Total[1]	0	325 (2%)[2]	325 (2%)[2]	325 (2%)[2]	59,886

[1]Total NFS acres in a lynx habitat category
[2]Values in parentheses represent percentage of NFS acres in the LAU that would be affected.

The following table summarizes the proposed disturbance of lynx habitats in project area (including portions of the Eagle Valley, Holy Cross, and Camp Hale LAUs).

Table 3–53 Lynx Habitats Affected within the Project Area

Lynx Habitats[1]	Potential Disturbance (Acres)				Total NFS (acres)
	Alternative A	Alternative B	Alternative C	Alternative D	
Denning	0	533 (6%)[2]	533 (6%)[2]	501 (6%)[2]	8,921
Winter	0	365 (2%)[2]	302 (2%)[2]	156 (1%)[2]	15,430
Unsuitable	0	26 (1%)[2]	26 (1%)[2]	26 (1%)[2]	2,654
Non Habitat	0	1,142 (5%)[2]	835 (4%)[2]	691 (3%)[2]	20,259
Other	0	648 (7%)[2]	498 (5%)[2]	438 (4%)[2]	9,947
Project Area Total	0	2,714 (5%)[2]	2,194 (4%)[2]	1,812 (3%)[2]	57,211[3]

[1]Total NFS acres in a lynx habitat category from January 2002 LCAS mapping
[2]Values in parentheses represent percentage of NFS acres in the LAU that would be affected.
[3] Total does not include approximately 15,000 acres of non-Forest Service administered land within the project area.

Direct effects to the lynx, including injury, mortality, disturbance, or displacement are not expected based on the lack of documented lynx occurrence in the project area and indication from recent Forest Service studies that denning habitat published by LCAS may not represent the actual denning habitat conditions within the project area.

Lynx Habitat Connectivity

Two lynx linkage polygons are within the project area, Dowds Junction and Vail Pass. No treatment units are proposed for the Vail Pass linkage polygon. Project activities would not disturb the current condition of this linkage polygon. Several treatment units would occur within the Dowds Junction linkage polygon. As described previously, these projects would modify lynx habitats. A complete analysis of the potential effects associated with changes in lynx habitats is provided in the preceding sections. The overall effectiveness of the Dowds Junction linkage polygon would not be reduced by the proposed projects. Furthermore, implementation of the proposed project would not diminish the movement of lynx within and among LAUs. This statement is based on the lack of current lynx movements within the project area and the likelihood that this is an indication of the less than optimal quality of the potentially suitable lynx habitats within the project area.

Changes in Winter Snow Compaction

Under Alternative B is a proposal to construct and use new temporary roads and trails in Grouse Creek and Stone Creek drainages. Project-related activities are not expected to occur during the winter months, and thus project-related use of these proposed roads and trails would not directly lead to increased snow compaction in the project area. However, recreational use of project-related roads is likely to occur during the winter months and subsequently increase the amount of snow compaction in the project area. Alternative B would not involve an increase in groomed, designated over-the-snow routes or snowmobile play areas in any of the LAUs occurring within the project area. **Table 3–54** summarizes the total acres of proposed temporary roads and trails within each LAU that may receive winter recreational use.

Table 3–54 Temporary Roads and Trails by LAU (Acres of Disturbance)

LAU	Alternative B	Alternative C	Alternative D
Eagle Valley	11	14	11
Holy Cross	22	22	22
Camp Hale	<1	<1	<1
Brush Creek	0	0	0
Project Area	33	36	33

Determination of Effect

Implementation of Alternative B may affect, but is not likely to adversely affect the Canada lynx. This determination is based on the potential for the project to displace non-breeding lynx in the project area, alter suitable lynx habitats, and affect suitable habitats for the snowshoe hare, an important prey species for the lynx.

Forest Service Sensitive Species

Species that are listed on the Rocky Mountain Regional Forester Sensitive Species List (October 2003) are addressed in detail in the BE prepared for this project. Sensitive wildlife species selected for analysis based on their known or potential occurrence in the project area and potential to be affected by the project are the following: the American marten, pygmy shrew, northern goshawk, American peregrine falcon, boreal owl, American three-toed woodpecker, olive-sided flycatcher, sage sparrow, Brewer's sparrow, and boreal toad.

Under Alternative B, 3,000 acres of lodgepole pine, aspen, mountain shrub, grass/forb, and sagebrush/rabbitbrush habitats would be disturbed. Treatments occurring within these cover types could damage or destroy habitats suitable for nesting, denning, or foraging for Forest Service sensitive species. This proposed disturbance is the highest predicted habitat disturbance. **Table 3–55** summarizes the potential disturbance to cover types. As previously discussed, actual treated acres may vary up to 15 percent from the values presented in the following table.

Table 3–55 Disturbance of Selected Cover Types (Acres)

Cover Type	Project Area	Alternative B	Alternative C	Alternative D
Lodgepole pine	16,104	696 (4%)[1]	696 (4%)[1]	696 (4%)[1]
Aspen	16,797	1,749 (10%)[1]	1,228 (7%)[1]	802 (5%)[1]
Sagebrush/Rabbitbrush	2,530	209 (10%)[1]	209 (10%)[1]	209 (10%)[1]
Mountain Shrub (Serviceberry)	2,676	64 (2%)[1]	1,400 (4%)[1]	1,200 (4%)[1]
Grass/Forb	12,659	72 (1%)[1]	72 (1%)[1]	72 (1%)[1]
Total Disturbance	50,766[2]	2,790 (5%)[1]	3,605 (7%)[1]	2,979 (6%)[1]

[1]Values in parentheses represent percentage of NFS acres available.
[2] Approximately 22,000 acres of other cover types not affected by the proposed project are not included

Table 3–56 presents the general habitat associations for the Forest Service sensitive species analyzed in this report.

Table 3–56 General Habitat Associations for Forest Service Sensitive Species of Wildlife

Species	Lodgepole Pine	Aspen	Sagebrush & Rabbitbrush	Mountain Shrub	Grass & Forb
American marten	X				
Pygmy shrew	X	X	X	X	X
Northern Goshawk	X	X			
American peregrine falcon	X	X			
Boreal owl	X	X			
American three-toed woodpecker	X				
Olive-sided flycatcher	X	X			
Sage sparrow			X		
Brewer's sparrow			X		
Boreal toad	X	X			

Depending on their ability to avoid or tolerate project-related activities, individuals of some species may experience injury, mortality, or displacement. Species particularly susceptible to these effects include the marten, pygmy shrew, and boreal toad. Unidentified nests and dens may also be disturbed or destroyed during project implementation, causing injury or mortality to eggs or young. These potential direct effects within the treatment units are not expected to diminish individual survivorship or threaten population status within the project area or Forest-wide.

The following is a summary of the determinations for Forest Service sensitive species from the BE.

Table 3–57 Summary of Determinations for Forest Service Sensitive Species of Wildlife

Species	Alternative A	Alternative B	Alternative C	Alternative D
American marten	NI	MAII	MAII	MAII
Pygmy shrew	NI	MAII	MAII	MAII
Northern goshawk	NI	MAII	MAII	MAII
American peregrine falcon	NI	MAII	MAII	MAII
Boreal owl	NI	MAII	MAII	MAII
American three-toed woodpecker	BI	MAII	MAII	MAII
Olive-sided flycatcher	BI	MAII	MAII	MAII
Sage sparrow	NI	MAII	MAII	MAII
Brewer's sparrow	NI	MAII	MAII	MAII
Boreal toad	NI	MAII	MAII	MAII

BI = Beneficial Impact
NI = No impact
MAII = May adversely impact individuals, but not likely to result in a loss of viability on the planning area, nor cause a trend toward federal listing or a loss of species viability rangewide

Management Indicator Species

Management indicator species (MIS) selected for analysis include the elk, snowshoe hare, and MacGillivray's warbler. An analysis for each of these species is provided in the following sections. Populations of MIS are monitored and evaluated at the Forest level, and therefore, population changes at the project level would be less significant given the scope of this project. The habitat changes and the anticipated effects these changes in habitat will have on the local population will be analyzed.

Elk

Under Alternative B, the prescribed treatments would affect 3,000 acres of lodgepole pine, aspen, mountain shrub, grass and forb, and sagebrush/rabbitbrush habitats. Although unlikely, implementation of prescribed treatments may cause direct injury or mortality for individuals that are unable to avoid human activities. Increased human activity associated with implementation of prescribed treatments may disrupt the behavior or displace individuals from otherwise suitable habitats. During calving, project activities may be delayed in some treatment units to avoid disturbing parturition.

Current elk population estimates are above the objectives established by CDOW for elk DAUs E-12 and E-16. Recent efforts by CDOW to manage elk populations have included an increase in the number of cow harvest tags issued to the public. Seasons and harvest objectives are expected to continue to be designed to decrease the herd size in the short term. It is likely that in the next several years, CDOW will report a decrease in the elk populations within DAU E-12 and E-16. Such notable population decreases would likely be the result of CDOW management practices and not the result of the proposed project. The established trigger in the elk MIS protocol is related to changes in cow-calf ratios and bull-cow ratios rather than gross population fluctuations that will occur in response to CDOW changes in hunting regulation. Implementation of the proposed project would not discernibly change elk population estimates or meet the MIS triggers outside the measures that are being used to reduce the herd size

At the project level, timber treatments would slightly reduce the quality of the treated area for elk during calving season and would reduce the amount of elk hiding cover in the short term by opening up sight distances within the timber stands. The enhancement of aspen stands would increase habitat quality in the local area by eventually providing an increase in hiding cover and forage sources. In timber stands with remnant aspen, treatments would release some aspen where presently there is little or no understory. The sagebrush treatments would have a beneficial effect by providing additional high quality winter forage in areas that have been affected by urban development.

In the long term, there would be a benefit to elk as the regeneration of the lodgepole stands would provide improved cover over habitat that currently exists in the mature stands.

Snowshoe Hare

Under Alternative B, 750 acres of lodgepole pine would be disturbed. Treatments occurring in lodgepole pine habitats, preferred by the hare, may result in direct injury or mortality of individual hares unable to avoid construction activities. Increased activity associated with implementation may disrupt normal use of some habitats, resulting in displacement of individual hares to other unaffected habitats. The proposed treatments represent less than 5 percent of the available lodgepole pine habitats in the project area. These potential effects to the snowshoe hare would not threaten the population status within the project area or the Forest. Results of the HABCAP model indicate no appreciable change in snowshoe hare habitat capability in the project area after implementation of the prescribed treatments.

In the long term, the treatments in lodgepole stands would benefit snowshoe hare as regenerating lodgepole pine grow above snow levels and provide winter forage for hares. Treatment of aspen would also benefit hares in the long term since more sapling aspen would be available for winter forage.

MacGillivray's Warbler

Under Alternative B, sagebrush and rabbitbrush shrublands that may support nesting and foraging habitats for this species would be treated. Implementation of the prescribed burning and mechanical treatments may destroy occupied nests, depending on the timing of the treatments. Pre-treatment nesting surveys and timing restrictions could be applied to reduce effects on nesting warblers and other nesting species. Alternative B would account for 209 acres of disturbance to potentially suitable warbler habitats, representing 10 percent of the sagebrush and rabbitbrush habitat in the project area.

Mechanical and fuel treatments in shrub habitats would reduce the amount of mature, decadent sagebrush and provide opportunities for new young sagebrush to establish, as well as new grass and forb microhabitats. These habitats, in association with other mature shrub habitats, may provide new foraging and nesting opportunities for this species. Project implementation would not threaten the population status of this species within the project area or the Forest. Results of the HABCAP model indicate no appreciable change in MacGillivray's warbler habitat capability in the project area after implementation of the prescribed treatments.

Species of Concern

The Forest Plan lists three wildlife species of special concern: mule deer, bighorn sheep, and peregrine falcon. Included within the project area are 5,217 acres of deer management prescription (MA 5.41) and 1,012 acres of bighorn management prescription (MA 5.42). Mule deer and bighorn sheep are known to occur in suitable habitats within the project area.

Although the peregrine falcon is known to nest in the Forest and within the Holy Cross District, there are no known nests on NFS lands within the project area. However, an active nest occurs on privately-owned lands within 10 miles of the project area. Birds associated with this nest may forage in the project area, however, the treatments in the sagebrush and mountain shrub habitats are outside the normal hunting territory of the known nest. The proposed treatments would not occur in preferred hunting habitats and would have little or no effect on the peregrine falcon.

Under Alternative B, the prescribed treatments are proposed for habitats occurring within the mule deer management areas, but none are prescribed for the bighorn sheep management area. Under Alternative B, the most profound direct effect to deer would be temporary displacement from suitable foraging in sagebrush habitats. In the long term, the treatments would benefit deer by replacing decadent plants with low productivity with younger plants that would be more productive. Activities in forested habitats may displace deer to other undisturbed habitats. These effects are not expected to be detrimental to individual health or population status because of the availability and condition of other suitable habitats within the management area and project area. Burning of sagebrush stands would likely create a mosaic of decadent sagebrush, young succulent sagebrush, and new patches of grasses and forbs. This increased diversity would provide deer and sheep with an increase in the availability and quality of forage.

Alternative C

The effects on wildlife under Alternative C would be the same as Alternative B, with one exception. The estimated acres of disturbance under Alternative C (2,500) would be less than under Alternative B.

Alternative D

The effects on wildlife under Alternative D would be the same as Alternative B, with one exception. The estimated acres of disturbance under Alternative D (2,200 acres) would be less than under Alternative B.

Cumulative Effects by Alternative

Alternative A – No Action

Effects from past, ongoing, and anticipated activities have influenced the availability and condition of lynx habitats in the project area. Activities influencing lynx habitats and prey species have included commercial and residential land development, recreational use, and vegetation management. These same activities can be reasonably expected to continue over time, further influencing lynx habitats. The effects of these activities combined with the effects from persistent mountain pine beetle (MPB) outbreaks and maturing vegetation would likely lead to a continued departure from suitable lynx habitats. These effects on lynx habitats and prey species would be expected to affect future lynx immigration into the project area.

Forest Service sensitive species have been affected by the same activities described above. These same activities and associated effects are expected to continue over time in the project area. Although effects from these activities are difficult to quantify, they likely include injury and mortality to sensitive species, displacement from otherwise suitable habitats, and alteration or removal of suitable habitats. Under the No Action alternative, mature lodgepole pine would persist until stands have been decimated by MPB or aging stands no longer provide suitable habitats for these species.

Management indicator species (MIS) are likely to experience similar effects over time, including direct injury or mortality, displacement from otherwise suitable habitats, and alteration or removal of suitable habitats. As previously described, past, ongoing, and anticipated activities in the project area influencing MIS have included commercial and residential land development, recreational use, and vegetation management. These activities are expected to continue and increase in the project area. Injury, mortality, displacement, and habitat destruction have likely occurred in the past and are expected in association with future activities in the project area. Under the No Action alternative, habitats that support MIS would continue to mature and MPB infestation would persist. This would lead to a gradual loss of habitats that support MIS species, particularly for species dependent on early seral stands. Current conditions that may provide suitable elk habitats, particularly hiding cover, would likely mature into less suitable elk habitats under the No Action alternative.

The snowshoe hare, an MIS and an important prey species for the Canada lynx, has likely experienced effects from past and ongoing actions in the project area. Alteration or removal of suitable early seral habitats has likely been the most profound effect on the snowshoe hare. Under the No Action alternative, areas of suitable hare habitat would continue to mature toward an over-mature condition that would not support hares. Although such habitats would eventually degrade and provide opportunity for early seral habitats, this change would occur over decades. Continued stand maturation and persistence of MPB is expected to eventually lead to a loss of these stands. The conversion of mature stands to early seral stages would occur over decades.

Past, present, and anticipated activities in the project area have altered or removed sagebrush that provides suitable nesting and foraging habitats for another MIS, the MacGillivray's warbler. With land development and recreational use expected to increase in the project area, additional habitats are likely to be damaged or destroyed. Under the No Action alternative, these effects, combined with the natural maturation of the sagebrush communities, would lead to habitats that are less available and suitable to the warbler. Older communities would lack younger more robust shrubs distributed among small areas of grass cover.

Other species of concern, including the mule deer, bighorn sheep, and peregrine falcon, also would experience the effects of past, ongoing, and anticipated human activities in the project area. Impacts to the availability and condition of habitat and effects from increased human presence would influence the mule deer population in the project area. Bighorn sheep and peregrine falcon occur in extreme habitats that have traditionally been less impacted by past and ongoing human activities. Increased land development and recreational use in the project area in the future may reach levels sufficient to displace these species from otherwise suitable habitats. Under the No Action alternative, some habitats would not be as effective as hiding or foraging cover for the mule deer as these stands age and outbreaks of MPB persist.

Alternative B

Cumulative effects to Canada lynx may include changing some lynx habitats from suitable to unsuitable, reducing dispersal (connectivity) habitat, and increasing the disturbance to any lynx that may be using the affected areas or adjacent areas. These effects may be the result of commercial and residential land development, recreational use, and vegetation management, as well as continued commercial and private development actions occurring within LAUs and the southern Rocky Mountain region.

Cumulative effects to Forest Service sensitive species may include direct harm or mortality, displacement, and disturbance or destruction of habitats. In some cases, future actions may benefit species by augmenting or creating new suitable habitats. These effects may occur as the result of future timber and fuels management actions, livestock grazing, recreational use, and private and commercial development.

Cumulative effects to MIS may include direct harm or mortality, displacement, and disturbance or destruction of habitats. In some cases, future actions may benefit species by augmenting or creating new suitable habitats. These effects may occur as the result of future timber and fuels management actions, livestock grazing, recreational use, and private and commercial development.

Because of the inherent stresses associated with over-populated habitats, any project-related effects on elk habitat or individual elk may have a sufficient incremental impact to result in diminished health or survivorship of individual elk. In some cases, future Forest Service management actions may benefit species by augmenting or creating new suitable habitats. These effects may occur as the result of future timber and fuels management actions, livestock grazing, and recreational management.

Cumulative effects to the snowshoe hare may include direct harm or mortality, displacement, and disturbance or destruction of habitats. Quantitative population data for the snowshoe hare are not available for the project area or the Forest. However, anecdotal evidence collected during other biological inventories indicates that snowshoe hare populations on the Forest are healthy and well distributed across suitable habitats. It is likely that project-related activities may result in harm to individual hares and would disturb suitable habitats. These effects are not expected to occur with sufficient frequency or magnitude to manifest population effects at the Forest level. Snowshoe hares are known to experience dramatic 10-year population cycles, which can often result in a 98 percent reduction of the hare population. Although such extreme population cycles may not be evidenced at the Forest-level, natural population fluctuations are expected. Project implementation is not expected to alter this natural cycle.

Although specific population data are not available for MacGillivray's warbler in the project area or the Forest, anecdotal observations by Forest Service staff indicate that this species occupies suitable habitats throughout the Forest. Although project activities may affect nests and suitable habitats, these activities would not impact the population at the Forest level. Long-term effects from the prescribed treatments in sagebrush may benefit the species by creating suitable nesting and foraging habitats. Private and commercial development of shrubland habitats is expected to have a more profound impact on this species at the Forest-level than Forest Service management actions.

Cumulative effects to species of concern (mule deer, bighorn sheep, and peregrine falcon) may include direct harm or mortality, displacement, and destruction of habitats. In some cases, future actions may benefit species by augmenting or creating new suitable habitats. Activities that may have positive or negative impacts on these species may include future timber and fuels management actions, livestock grazing, recreational use, and private and commercial development.

Alternative C

The cumulative effects for Alternative C would vary only slightly from those described above for Alternative B – Proposed Action. These variations are described below.

Under Alternative C, broadcast burning would not occur. While mechanical treatments under Alternative C would be effective in reducing fuel loads that contribute to wildland fire hazards, Alternative C would not add diversity to the successional stages present in shrublands north of the I-70 corridor, as overmature and decadent shrublands would not be replaced by young vegetation after broadcast burning.

Alternative D

The cumulative effects for Alternative D would vary only slightly from those described above for Alternative B – Proposed Action. These variations are described below.

Under Alternative D, fuels treatments would occur on fewer acres and aspen enhancements would occur on 160 fewer acres in the Vail Intermountain area than under Alternative B. The limited acreage treated outside the Game Creek inventoried roadless area might not have any noticeable effect on the vigor or size of aspen stands in the Vail Intermountain area, and may not retard the encroachment of conifers.

Forest Plan Consistency

A review of the applicable Forest Plan guidance was conducted and summarized in the affected environment section. The proposed project is in compliance with all applicable standards and guidelines. Compliance with Canada lynx and MIS habitat guidance is summarized below.

Forest-wide Canada lynx standards require that if 30 percent of the lynx habitat within a LAU is currently in an unsuitable condition, no further reduction of suitable conditions shall occur as a result of vegetation management by federal agencies. Additionally, management actions such as timber sales, salvage sales, and prescribed fire should not change more than 15 percent of lynx habitat within a LAU to unsuitable condition within a 10-year period. Where less than 10 percent denning habitat is currently present within an LAU, management actions that have the highest potential for developing denning habitat structure in the future must be deferred. Also, salvage harvest following a disturbance, such as a MPB outbreak, should only occur when the affected area is larger than 5 acres.

The LAUs occurring within the project area currently have much less than 30 percent of the habitat designated as unsuitable. Additionally, none of the action alternatives would change more than 15 percent of lynx habitat to unsuitable condition (**Table 3–50** through **Table 3–53**). Recent Forest Service field studies indicate that the data in the Lynx Habitat GIS layer may not adequately characterize the lodgepole pine forest type over much of the Holy Cross Ranger District, including the project area. Since less than 10 percent denning habitat may be present within the affected LAUs, vegetation management actions in aging lodgepole pine stands that have high potential for developing denning habitat structure have been deferred in the Meadow Mountain B inventoried roadless area and in the vicinity of the Whiskey Creek landslide.

For MIS, a HABCAP analysis was conducted to assess the potential changes to elk habitat effectiveness indexes. The Forest Plan Standard for elk habitat effectiveness index (HEI) is 0.45. The estimated pre-project HEIs for DAU 12 and DAU 16 are 0.47 and 0.39, respectively. Implementation of the alternatives would not appreciably lower the pre-project effectiveness indexes for DAUs 12 and 16. Therefore, each of the alternatives is in compliance with the standard.

Irreversible and Irretrievable Commitments

Irreversible effects are those that cannot be reversed, thus causing the permanent loss or change to the resource. An example of an irreversible effect is the extinction of a species or the mining of an ore. No irreversible effects to wildlife would occur as the result of implementation of the project. Irretrievable effects are those that may be lost for a period of time. An example of an irretrievable effect is the removal of a forest for construction of a highway. As long as the highway is present, timber productivity for the removed stands is considered an irretrievable commitment of the resource. For the VVFH project, irretrievable effects to wildlife could include the following:

- Loss of habitat for sensitive and MIS species.
- Harassment and displacement of sensitive and MIS species.

3.3.5 Aquatic Life

Resource Description

Aquatic life, including fish species that occur within the project area or downstream, could be impacted by the proposed project. Project activities could affect fish resources through injury, mortality, disturbance, or alteration of habitat.

Indicators

- Effects on federally listed species
- Effects on Forest Service sensitive species
- Effects on Management Indicator Species (MIS)
- Effects on species of concern
- Effects on species of viability concern

Forest Plan Direction

Overall management direction for the WRNF includes the national strategic goals of protecting ecosystem diversity and productivity by maintaining viable populations of all native and desired non-native fish in habitats throughout their geographic range; producing habitat capability levels to meet objectives for MIS; and providing diverse opportunities for use of fish resources in accordance with local demands (Forest Plan, page AA-4). This is further emphasized in the regional goal of providing for a variety of life through management of biologically diverse ecosystems (Forest Plan, page 1-1).

Forest-wide goals and strategies for fish resources include promoting ecosystem health and conservation and protecting stream flow and habitat, sustaining viable populations, achieving MIS objectives, (Forest Plan, page 1-3), expanding Colorado River cutthroat trout (CRCT) habitat and population numbers (Forest Plan, page 1-6), emphasizing fish management activities that assure natural processes and conform with the Wilderness Act in designated wilderness (Forest Plan, page 1-11), and cooperating with CDOW to achieve desired population objectives (Forest Plan, page 1-12) Forest-wide goals and strategies for the protection and improvement of watershed conditions (Forest Plan, page 1-3) also protect aquatic ecosystem values.

Forest-wide standards and guidelines for the CRCT (Forest Plan, pages 2-22 to 2-23) apply to all areas of the WRNF and include: maintaining or enhancing existing habitat; maintaining or reducing the existing net density of roads within the subwatersheds containing cutthroat trout; and decommissioning temporary roads in subwatersheds containing cutthroat trout upon project completion. Forest-wide standards and guidelines for soils, water, and riparian resources (Forest Plan, pages 2-4 to 2-7) also protect aquatic ecosystem values.

Desired Condition

The desired condition for the Forest is to provide suitable biological and abiotic conditions that support viable populations of native, desired non-native, and protected fish species. Resources are managed in MA 5.4 to protect, enhance, and restore habitat for native fishes.

Temporal Scope

The temporal scope includes the period immediately following implementation of the proposed treatments. This is anticipated to be the period of greatest alteration of factors influencing soil erosion, runoff, and sediment transport. As time passes following implementation of the proposed treatments the magnitude and intensity of these effects would decline due to:

- Reclamation of temporary roads, landings, and skid and tractor trails;
- Removal of temporary road channel crossings;
- Re-establishment of surface drainage;
- Increased evapotranspiration from forest and shrubland regeneration; and
- Decomposition of felled trees, and redistributed slash and coarse woody debris.

Geographic Scope

The area within which fish resources may be directly or indirectly affected is the project area. The area of potential effect includes the proposed treatment units and nearby areas that may be affected by reconstructed or temporary roads. This would include effects to individuals or populations and preferred habitats within the project area.

The project area boundary includes the Gore Creek watershed, and a portion of the Eagle River watershed. In Gore Creek, the project boundary extends west from Vail Pass to the confluence with the Eagle River. In the Eagle River, the project boundary extends from the mouth of Cross Creek near Minturn, to McCoy Creek below the town of Avon. Gore Creek has a drainage area of more than 100 square miles, while the Eagle River above Avon has a drainage area of more than 420 square miles.

Affected Environment

This section provides a brief overview of federally listed fish species, Forest Service sensitive species, MIS, species of concern, and species of viability concern that may occur within the project area. No species of concern or species needing more baseline inventory or evaluation have been identified on the WRNF (Forest Plan, pages EE-3 and EE-6). A more detailed presentation of the aquatic indicators may be found in the *Project File* at the Holy Cross Ranger District Office in Minturn, Colorado.

Federally Listed Species

The FWS lists four endangered fish species in Eagle County, Colorado: Colorado pikeminnow; humpback chub; razorback sucker; and bonytail chub. Life histories and potential effects of the proposed

action on these species were addressed in the BE. Because these species occur in the Colorado River Basin outside the project area, and no water depletion would be associated with the proposed project, there would be no effect on these species. Potential effects on these species were not addressed further in this analysis.

Forest Service Sensitive Species

Five Forest Service sensitive fish species have been designated for the WRNF (USFS 2003c). The BE, on record for this project presents a complete analysis of potential effects of the proposed project on these sensitive species. The Colorado River cutthroat trout (CRCT) was the only Forest Service sensitive fish species analyzed in detail. The remaining species, including the bluehead sucker, flannelmouth sucker, mountain sucker, and roundtail chub are considered large river species and are not expected to experience effects resulting from this proposed project.

A review of the CDOW database in 2001 documented CRCT in nine streams that occur within the Vail Valley project area. **Table 3–58** summarizes the CRCT distribution data collected in the past 30 years.

Table 3–58 Distribution of Colorado River Cutthroat Trout

Stream	No. of CRCT	Stream	No. of CRCT	Stream	No. of CRCT
Bighorn	0	Upper Gore[1]	No data	Mill	0
Booth	18	Gore (Eagle R to Black Gore)	16	Nottingham[1]	No data
Buck	0	Grouse	0	Pitkin	5
Buffer	14	West Grouse	0	Red Sandstone	0
Cross#2 (west fork cross to headwaters)	21	Indian	29	Spraddle	0
Cross (Eagle R to West Fk cross)	0	Martin[1]	No data	Stone	0
West Cross (south of Avon)	11	McCoy	7	Timber	0
Game	1	Middle[1]	No data	Whiskey[1]	No data

[1] No data found electronically or by searching records at the CDOW office in Montrose.

Conservation populations of CRCT within the project area are listed in **Table 3–59**. This information is summarized from the Vail Valley Aquatic Species Specialist Report (USFS 2003b).

Table 3–59 Conservation Populations of Colorado River Cutthroat Trout

4th Level	6th Level Watershed	Stream	Genetic Purity	Population Type
Eagle	Red Sandstone	Indian Creek	B+	Conservation
Eagle	Cross	West Cross Creek	A-	Core
Eagle	Cross	Cross #2 (West Cross Creek to headwaters)	A	Core
Eagle	Pitkin	Pitkin	B	Conservation

Management Indicator Species

Management Indicator Species (MIS) are species whose response to land management activities can be used to predict the likely response of a wide range of species with similar habitat requirements. Aquatic MIS were established to address physical stream habitat, water quality, and winter water depletions. Aquatic MIS selected for this analysis include macroinvertebrate communities and total trout density (Forest Plan, page EE-3). Because there is no water depletion associated with the proposed project, potential impacts to brown trout (fall spawning) and brook trout (fall spawning) habitats are not expected. These species will not be addressed in this report.

All Trout

Trout (all species) was selected as an MIS to evaluate whether the proposed project would maintain or improve the physical habitat quality for salmonids in mountain streams. Historic Forest-wide population data collected by the CDOW, indicate trout have occupied every fish-bearing stream or lake on the Forest. These 25 year-old data represent the most comprehensive assessment of trout species occurrence and distribution on the Forest. Subsequent stream and lake sampling has occurred throughout the Forest, but these efforts tended to be project specific and not intended to contribute to Forest-wide analyses.

In 2003, the WRNF began its Forest-wide aquatic MIS monitoring. Nine randomly selected sites were monitored for all trout and aquatic macroinvertebrates. Additional sites will be sampled each year for the next 4 years. Future monitoring efforts will include re-sampling sites.

Historic CDOW fish data relevant to the project area were reviewed. Historical data were available for 19 of the 25 fish-bearing streams within the project area. In 2002, the Forest Service conducted fish inventories in 12 of the fish bearing streams in the project area. Results from the 2002 survey were compared to the earlier CDOW surveys. The overall trend appears to be a decline in the number of individual fish among the brook, brown, rainbow, and Colorado River cutthroat tout. Notable exceptions include dramatic increases in the number of brook trout and cuttbow (hybrid) individuals recorded in Red Standstone, Mill, and Stone Creek. Refer to the Vail Valley Aquatic Report for a complete assessment of fisheries within the project area (USFS 2003b).

Macroinvertebrates

Aquatic macroinvertebrates were selected as an MIS to evaluate whether the proposed project would maintain or improve water quality (including chemical aspects, as well as sediment). Macroinvertebrate samples were not collected within the project area. The following information is summarized from the Vail Valley Aquatic Life Report (USFS 2003b).

Streams within the project area are presumed to contain diverse macroinvertebrate populations, including mayflies, caddisflies, and stoneflies, which indicate good water quality and an abundant food source. No site-specific macroinvertebrate sampling was conducted in the project area. Adjacent watersheds were discussed in the macroinvertebrate section of the Vail Valley Aquatic Life Report contained in the *Project File*. Forest-wide macroinvertebrate sampling was completed in three watersheds on the east side of the WRNF. Data from this effort were not available during the preparation of this report.

Species of Viability Concern

There are six fish species designated as species of viability concern for the WRNF (Forest Plan, page EE-4). The Final Biologist's Report provides justification for species selection and a complete analysis of potential effects on selected species. The CRCT is identified as a species of viability concern and a Forest Service sensitive species for this analysis. This species was also addressed earlier in this section under Forest Service sensitive species. No other species of viability concern were addressed in this analysis

Environmental Effects

Direct and Indirect Effects by Alternative

Alternative A – No Action Alternative

The CRCT is the only Forest Service aquatic sensitive species addressed in this report. Under the No Action alternative, no timber or fuel treatments would occur within the project area. Therefore, there would be no direct effects on the CRCT. Under Alternative A, the determination for this species is no impact. This determination is based on the absence of new impacts to this species and continuation of existing Forest Service management actions.

There also would be no direct effects to habitat condition or water quality in streams supporting CRCT, other trout species, and aquatic macroinvertebrates. There would be no new impacts to fall or winter stream flows, thus avoiding the spawning periods for brook trout and brown trout. Implementation of this alternative is not expected to threaten the status of trout populations or macroinvertebrate communities in the project area or within the Forest.

Alternative B

No federally listed aquatic species would be affected by the proposed project. Effects on aquatic resources are organized by protective status (Forest Service sensitive species and MIS). The complete description of species selection and analysis of effects, evaluations, and associated determination statements are provided in the BE. The BE is included in the *Project File*.

Forest Service Sensitive Species

Under Alternative B, there would be no direct or indirect effects to aquatic habitats that are occupied by conservation populations of CRCT. Prescribed treatments would include appropriate measures to minimize alteration or sedimentation of occupied aquatic habitats, including West Cross Creek, Indian Creek, Red Sandstone, and Pitkin Creek, where CRCT have been collected. Except for the prescribed burn units identified adjacent to the lower reaches of Pitkin Creek, no other treatment units occur adjacent to or up gradient of known CRCT populations. Project implementation would not degrade CRCT habitats and would not threaten the status of CRCT populations within the project area or the Forest.

For CRCT, implementation of the proposed project under Alternative B would result in a determination of may adversely impact individuals, but is not likely to result in a loss of viability in the planning area nor cause a trend toward federal listing or a loss of species viability rangewide. The following is a summary of the determinations for CRCT.

Management Indicator Species

Aquatic MIS evaluated for this project include trout (all species) and aquatic macroinvertebrates. The MIS checklist is included in the *Project File*. Selection of MIS and the subsequent analysis were conducted in accordance with the Region 2 Management Indicator Species "Checklist" for Decision-Makers (Phinney 2004). Under Alternative B, there would be only one temporary effect to fish-bearing streams or lakes. This would include an increase of 1 percent in SNE in the Grouse Creek watershed due to the construction of a temporary road across a WIZ of a third order and larger stream. The SNE increase in the Grouse Creek watershed would bring the total SNE in the watershed to almost 2 percent, which is well below the WCP handbook's design criteria of 10 percent SNE. Therefore, the stream health class of Grouse Creek would not change following implementation of Alternative B with the BMPs described in **Appendix D**.

There would be no water depletions associated with Alternative B. Implementation of conservation measures would minimize the potential for sedimentation of local streams. Winter and spring flows would not be affected, thus avoiding impacts to spawning periods for the brown and brook trout. Road improvement efforts associated with the proposed project may improve existing stream conditions at two crossings of second order or smaller drainages, making them more suitable for resident trout. Although the potential for degradation of stream health in Stone, Red Sandstone, Metcalf, Game, and Nottingham Creeks may impact individual trout and macroinvertebrates, these effects would not threaten the status of trout and macroinvertebrate populations within the project area or within the Forest.

Alternative C

The effects on aquatic life under Alternative C would be the same as the effects for Alternative B.

Alternative D

The effects on aquatic life under Alternative D would be the same as the effects for Alternative B.

Cumulative Effects by Alternative

Alternative A – No Action

Aquatic life is dependent upon healthy stream habitats and high water quality. Effects from past, ongoing, and anticipated sediment-producing activities on public and private lands within the project area would contribute to cumulative impacts on streams and aquatic life. The impacts from urban development on private lands are evident and are likely to become more evident over time. The effects of most prior management activities on NF administered lands on stream health in the project area have been documented and are primarily related to roads, trails, and recreation facilities, including Vail and Beaver Creek ski resorts. The effect of the existing road system on streambed sediment was measured in Stone and Grouse Creeks in 2002 (USFS 2003b). Stream health for fine sediment is robust in both streams, with substrate conditions comparable to that found in reference streams.

Roads, trails, ski trails, highway maintenance (e.g. sanding along I-70 for traction), and urban developments are contributing to relatively high levels of runoff, erosion, and sedimentation to streams. The number of skier visits at the two resorts has increased 45 percent in the last 15 years. Therefore, facilities on NF administered lands and private housing developments will likely increase in the foreseeable future. Newly constructed facilities at the ski resorts and on private lands will continue to make the largest contributions to stream sedimentation and impacts to aquatic life in the project area for the foreseeable future. The demand for new construction on private lands in the project area will continue to rise as it did for the period 1990 to 2000.

Table 3–40 in the Vegetation section of this chapter identifies past vegetation management activities in the project area. The cumulative effects of these activities on streams and aquatic life should be short-lived, based on the implementation of design criteria and BMPs during treatment activities, and reclamation following activities. This impact to aquatic life in the project area should be small in comparison to the contribution from development on private lands, described above.

Cumulative effects on Forest Service sensitive fish species have likely included damage or destruction of suitable aquatic habitats and detrimental effects to water quality. Past and ongoing activities that have the potential to affect stream habitats or water quality include commercial and residential land development, recreational use, timber harvest, and livestock grazing. Each of these activities can physically alter live water bodies, as well influence local water quality by increasing surface runoff, sedimentation, and introduction of chemical and physical contaminants. It is expected that land development, vegetation management, and recreational use would continue to increase in the project area, impacting aquatic species and their habitats. Under the No Action alternative, the advantage of implementing associated project design criteria that would improve existing stream crossings would be missed and ongoing impacts would continue.

Alternative B

The cumulative effects for Alternative B would vary only slightly from those described above for Alternative A – No Action. These variations are described below.

The VVFH project would add to past and ongoing activities on NF administered lands. Most effects on streams and aquatic life from the proposed treatments would be localized in the vicinity of the treatment units due to the implementation of design criteria and BMPs that would reduce the transport of sediment and prevent most project-related sediment from reaching streams that are downgradient of the proposed treatments. Design criteria that would address existing and potential impacts to aquatic habitats would be included under Alternative B. Habitats impacted by past or present activities may benefit from implementation of the project-related design criteria.

Reasonably foreseeable Forest Service management activities in the project area would not be expected to contribute to cumulative conditions that would not meet Forest Plan guidance. Possible re-entry after 10 years into the lodgepole pine treatment units where ladder fuels need treatment or not enough basal area was removed under Alternative B to effectively modify future mountain pine beetle (MPB) risk would not be expected to result in cumulative conditions that would exceed the project-only effects on aquatic life, provided design criteria and BMPs comparable to the measures described in **Appendix D** are followed during re-entry treatments. With the implementation of sediment and erosion control measures for the proposed treatments, stream sedimentation rates should diminish.

The cumulative effects of the proposed project on streams and aquatic life should be short-lived, assuming the effective and comprehensive implementation of design criteria and BMPs during treatment activities, and reclamation following activities. Impacts to streams and aquatic life in the project area should be small in comparison to the contribution from development on private lands, described above. The site-specific layout of treatment units with respect to stream buffers (WIZ) and implementation of design criteria and BMPs would limit sedimentation of streams and effects on aquatic life.

Alternative C

The cumulative effects for Alternative C would not be expected to vary from those described above for Alternative B.

Alternative D

The cumulative effects for Alternative D would not be expected to vary from those described above for Alternative B.

Forest Plan Consistency

A review of the applicable Forest Plan management guidance was conducted and summarized in the Affected Environment section. All alternatives are in compliance with these strategies, standards, and guidelines.

Irreversible and Irretrievable Commitments

Irreversible effects cause permanent loss or change to the resource. An example of an irreversible effect is the extinction of a species or the mining of an ore. Irretrievable effects are those that may be lost for a period of time. An example of an irretrievable commitment of resources is the removal of a forest for construction of a highway. No irreversible or irretrievable effects to aquatic life would occur as the result of implementation of the alternatives.

3.4 THE HUMAN ENVIRONMENT

Humans have an undeniable effect on ecosystems, especially in changing the physical and biological environments. The Forest Service is committed to balancing human needs and desires with protecting the physical and biological environment. The human environment is presented in six sections: heritage resources, lands and minerals, recreation resources, scenic resources, transportation, and social and economic resources.

3.4.1 Heritage Resources

Resource Description

Section 106 of the National Historic Preservation Act and its implementing regulations require inventory and consideration of potential effects of any federal undertaking on historic properties - heritage resources that are listed on or eligible for the National Register of Historic Places (NRHP). Activities in the project area could lead to the identification of unknown heritage resources. If potential heritage resources were identified, the Forest Service would immediately implement practices to avoid and protect them.

Indicators

- Effects on heritage resources
- Effects on eligible sites
- Effects on unknown sites

Forest Plan Direction

Forest-wide goals include incorporating tribal resource management values into forest management activities (Forest Plan, page 1-16). Forest-wide standards for American Indian rights and interests and heritage resources include protecting important cultural areas for current and future tribal use by recognizing the cultural landscape and geographic diversity left by Ute ancestors. This includes acknowledging intellectual property rights; protecting sensitive and proprietary traditional tribal knowledge; conducting all land management activities in such a manner as to comply with all applicable federal, state, and local regulations; and leaving human remains undisturbed unless there is an urgent reason for their disinterment (Forest Plan, page 2-33).

Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations, require that any federal undertaking consider impacts to historic properties. All historic properties will be identified and protected by completing heritage resource surveys prior to any direct or indirect impact from the project. Heritage resource values can be protected effectively by implementing the provisions of the following federal laws and their respective regulations:

- National Historic Preservation Act of 1966 (PL-89-665, as amended)
- National Environmental Policy Act of 1969 (P.L. 91-190)
- American Indian Religious Freedom Act of 1978 (P.L. 95-431)
- Native American Graves Protection and Repatriation Act of 1990 (P.L. 101-601)
- Religious Freedom Restoration Act of 1993 (PL 103-141)

In the event of accidental disturbance of historic graves or reinterment, the appropriate tribal, state, and forest policies will be followed. Forest policies are contained in the Burial Policy for the White River National Forest. The policies of the Southern Ute Indian Tribe are presented in Burial Policy for the Protection of Burial Sites, Human Remains and Funerary Objects.

The Forest Plan also establishes guidelines for protecting significant heritage resource sites from damage by project activities or vandalism through project design, specified protective measures, monitoring, and coordination. In addition, the guidelines specify that sites on the National Register of Historic Places be managed under approved management plans or annual operation plans (Forest Plan, page 2-33).

Consultation with American Indian people is recommended when projects have the potential to affect cultural rights and practices to help ensure the protection, preservation, and use of areas that are culturally important to tribes. Physically affecting the integrity of traditional cultural properties, including forest products collecting places, should be avoided when possible. The Forest Service National Resource Book on American Indian and Alaska Native Relations should be used when developing an agency-to-tribe consultation process (Forest Plan, page 2-33).

Desired Future Condition

The Forest Plan identifies no explicit desired future condition for heritage resources.

Geographical Scope

The area within which heritage resources may be directly or indirectly affected is the project area. The area of potential effects includes the proposed treatment units and nearby areas that may be affected by temporary roads.

Temporal Scope

The time period within which heritage resources may be directly or indirectly affected is the duration of project implementation.

Affected Environment

This section provides a brief overview of the heritage resources within the project area, with an emphasis on areas of proposed management activities. More detailed information can be found in heritage resource inventory reports in the *Project File* located at the Holy Cross Ranger District Office in Minturn, Colorado.

Heritage resources are the remains of districts, sites, buildings, structures, and objects used by past residents or travelers. Heritage resources are non-renewable resources that contain information on prehistoric and historic peoples who once inhabited or used the area. If these resources are damaged or improperly removed, they are irreversibly lost.

Beginning with systematic surveys for the Beaver Creek Ski Area in the 1970s, large portions of the project area have been surveyed for heritage resources. A private archaeological firm and Forest Service archaeologists recently conducted heritage inventories (Francis and Latham 2002; Brogan 2003) to study areas of proposed MPB management and fuel treatment areas that had not been adequately covered by previous inventories. The technical reports of the inventories were sent to the State Historic Preservation Office (SHPO) for review, and the SHPO has concurred with the findings of the reports. Ten treatment units (aspen stands where cutting and prescribed burning is proposed) remain to be surveyed. However, steep slopes (greater than 35 percent) dominate the majority of the latter areas, and the potential for significant heritage resources is expected to be low.

Twenty-four heritage resources have been documented in the project area. Two of the resources (5EA1555 and 5EA2114) are recommended as eligible for the NRHP and four resources are recommended as needing data in order to fully evaluate their eligibility (5EA72, 5EA73, 5EA882, and 5EA2117). Sites that are eligible or potentially eligible (need data) for the NRHP will be avoided and protected. Non-eligible sites will also be avoided and protected to the extent feasible on a case-by-case basis. The sites needing additional data are not within areas of proposed impacts. Plans are being developed for the avoidance and protection of the two eligible sites (5EA1555 and 5EA2114).

The Ute Indian Tribe and the Southern Ute Indian Tribe were consulted during the planning process and the tribes visited the eligible sites in June and July of 2003. Consultation has occurred on site 5EA1555 during a previous timber sale (the Green Bear timber sale), and measures have been successfully implemented to protect the site from continued use and maintenance of National Forest System Road (NFSR) 733. Both tribes felt that site 5EA2114 should be protected during the project's temporary use of NFSR 748. Representatives of the Ute Indian Tribe demonstrated that the site area was larger than recorded and felt that there were more components and greater significance to the site. Their first recommendation was that the road through the site not be used to haul timber. Their second recommendation, if the road must be used, is that the site be protected in a manner similar to site 5EA1555, that activities at the site be actively monitored during the timber operation, and that the road be left in place and closed to traffic after the project is completed.

Environmental Effects

Direct and Indirect Effects by Alternative

Alternative A - No Action

Significant sites are protected by the federal laws listed under Forest Plan direction, above, as well as other mandates and laws. Sites will be protected during ongoing forest management activities by mitigations such as re-routing roads, covering potentially affected portions of sites with layers of protective material, and avoidance. However, avoidance and protection may reduce, but not eliminate impacts. Public access and use may continue to erode, damage, or destroy sites in urban interface areas.

Alternative A, the No Action alternative would include continued short-term use of NFSR 733 and NFSR 748. NFSR 733 is a permanent road that crosses a portion of eligible site 5EA1555. Measures have been implemented to minimize effects to site 5EA1555 from continued use of NFSR 733. The effectiveness of these measures needs to be monitored. NFSR 748 includes a restricted portion that leads to the line shack. Continued use of this road would affect eligible site 5EA2114. The impacts of the present pattern of use are from occasional small vehicles.

Alternative A would potentially have a lower impact over the short-term on heritage resources because there would be less potential for disturbance to heritage resources in the area. However, under the No Action alternative, fuel loads would increase over time, and the extent or severity of wildland fires could increase. If a wildland fire moved through the project area, it would potentially have a high impact on known and unknown heritage resources. A fire could destroy the surface remnants of recorded heritage sites and may alter the subsurface chemistry and composition of soil horizons. Extreme heat in the upper levels of archaeological sites often destroys biological and physical data important to the scientific interpretation of those sites. Surface remnants of sites could be washed away by erosion and runoff from burned areas. A wildland fire would cause substantially greater impacts to heritage resources than vegetation treatments.

The No Action alternative would have the least effect on known heritage resources. Continued limited vehicle use of this portion of NFSR 748 to access the line shack, and non-vehicle use to reach recreational trails would continue to accelerate surface erosion at the site and provide the opportunity for illegal collection of artifacts. Temporary improvements to the road may reduce those risks.

Alternative B

Ground-disturbing activities such as timber harvest and road construction can directly bury, damage, or obliterate a cultural site. Significant sites are protected by the federal laws listed under Forest Plan direction, above, as well as other mandates and laws. Sites will be protected during any activity by mitigations such as re-routing roads, covering potentially affected portions of sites with layers of protective material, and avoidance. However, avoidance and protection may reduce, but not eliminate impacts. Increased access and use may continue to erode, damage, or destroy sites in urban interface areas. The effects of wildland fire under Alternative B would be similar to Alternative A, but reduced fuel loads under Alternative B may lessen the severity or extent of burns, reducing the potential effects of wildland fires on heritage resources.

Prescribed fire or erosion and runoff from burned areas could potentially impact known and unknown heritage resources. A controlled burn could damage the surface remnants of recorded heritage sites and may alter the subsurface chemistry and composition of soil horizons where pockets of detrimental burning occur. Surface remnants of sites could be washed away by erosion and runoff from burned areas.

Alternative B includes continued use and maintenance of NFSR 733 and proposed temporary improvements to NFSR 748. Vehicle use of NFSR 748 to access the line shack and non-vehicle use to reach recreational trails would continue to accelerate surface erosion at eligible site 5EA2114 and provide the opportunity for illegal collection of artifacts. Temporary improvements to the road may reduce those risks.

NFSR 733 crosses a portion of eligible site 5EA1555. The affected portions of the latter site have been covered by protective material and the dirt and gravel roadbed has been laid on top of the protective material. This protective measure prevents ground disturbance from road maintenance within the site. Alternative B also includes temporary improvements to and an extension of NFSR 748 for access to Units 103 to 106 by logging trucks and equipment. These temporary improvements would include upgrading the road where it passes through eligible site 5EA2114. There is not a viable alternative access route for these units that would avoid this site. The same protective measures used for site 5EA1555 are proposed for site 5EA2114. The existing road through the site would be covered with protective material and a dirt and gravel roadbed would be laid on top of the protective material. This would protect the site from ground disturbance caused by heavy traffic and road maintenance. At the conclusion of the project, the road would left in place and closed to traffic.

There is always the potential to damage undocumented or undiscovered sites. Surveys have been completed in the areas of potential effects, including access routes. The potential for undiscovered heritage resources is low. However, if a site is discovered during the project, the Forest Service will stop work in the area of the discovery until a Forest Service archaeologist can evaluate the site, and, if necessary, implement protective measures. If a Traditional Cultural Property or sacred site is found, all activity in the vicinity of the discovery will cease, and a Ute tribal representative will be notified.

Alternative C

The potential effects on heritage resources under Alternative C would not be expected to vary from those described above for Alternative B, with the following exception. No effects on heritage resources from broadcast burns would occur under Alternative C. Mechanical treatments proposed under Alternative C could increase ground disturbance in fuels treatment units where only broadcast burning would have occurred under Alternative B.

Alternative D

The potential effects on heritage resources under Alternative D would not be expected to vary from those described above for Alternative B, with the following exception. Fewer acres of prescribed burns are proposed under Alternative D than would occur under Alternative B. Potential effects of prescribed burns on heritage resources would be reduced under Alternative D.

Cumulative Effects by Alternative

Alternative A - No Action

Management activities of all kinds have the potential to impact heritage resources. In that sense, the effects of past and current actions continue to impact the heritage resource base. It is reasonable to assume that future management will continue to reduce the heritage resource base over time. Past, current, and reasonably foreseeable management actions all contribute to a downward trend in the heritage resource base given the fact that it is nonrenewable. There are no known or reasonably foreseeable actions that would reduce the heritage resource database in the project area. No recently completed projects adversely impacted heritage resources.

Past, present, and reasonably foreseeable future actions provide the opportunity to locate and protect otherwise unknown heritage resources. Continued use of the project area for recreation will include vehicle and pedestrian traffic through heritage resources and removal of artifacts by illegal collectors. At the same time, knowledge gained from heritage resources documented for this project adds to our knowledge of the prehistory and history of Colorado.

Alternative B

The cumulative effects on heritage resources under Alternative B would not be expected to vary from those described above for Alternative A, with the following exception. The proposed project would provide the opportunity to locate and protect otherwise unknown heritage resources, adding to our knowledge of the prehistory and history of Colorado.

Alternative C

The cumulative effects on heritage resources under Alternative C would not be expected to vary from those described above for Alternative B

Alternative D

The cumulative effects on heritage resources under Alternative D would not be expected to vary from those described above for Alternative B.

Forest Plan Consistency

The project alternatives are consistent with the Forest-wide goals to incorporate tribal resource management values into forest management activities (Forest Plan, page 1-16). All alternatives can meet these goals by implementing avoidance and protective measures for heritage resources and traditional cultural uses.

Irreversible and Irretrievable Commitments

Any damage to or loss of heritage resources is an irreversible and irretrievable commitment of resources. The best protection for any heritage resource or cultural use is avoidance of activities within the resource, except for monitoring of effects and maintenance. If any action may affect a heritage resource, site-specific recommendations for protection of the resource must be formulated before implementing the activity.

3.4.2 Lands and Minerals

Resource Description

Lands and minerals were not raised as a key issue for this project; however, concern was expressed that boundaries of private lands, wilderness, and roadless areas near planned treatments should be identified. This will ensure that treatments occur only on NFS lands and that the appropriate treatments within designated wilderness and inventoried roadless areas occur as planned. Proposed treatments should be coordinated with any lands and minerals activities, including special use authorizations, that are likely to occur in the vicinity of the proposed treatments.

Indicators

- Effects on lands and minerals activities (Forest Service administrative facilities, non-recreation special uses, active unpatented mining claims, mineral leases, or mineral material sale permits) as number, type, and acres affected

- Effects on landline locations (NFS land boundary, private property landlines, designated wilderness, inventoried roadless areas, rights-of-way and special uses, and ski area permit boundaries) as miles affected and miles of survey needed

Forest Plan Direction

The overall direction for managing the WRNF includes national strategic goals for the management of lands, minerals, and special uses to provide for multiple uses in an environmentally acceptable manner. Property boundary lines should be visible on the ground and should accurately depict the location of landownership lines for the protection and management of NFS lands and resources. Exploration of mineral and energy resources is encouraged and should be integrated with the planning and management of other national forest resources. Occupancy and use of land and resources should serve the interests of the public and the United States and should be consistent with the purpose of the NFS. Management of special uses should meet the needs of private interests, intermingled and adjacent landowners, and other jurisdictions for access to and across NFS lands, including reasonable access to private land (Forest Plan, pages AA-6, AA-7, and AA-15).

Desired Future Condition

The Forest Plan identifies no explicit desired future condition for lands and mineral resources.

Temporal Scope

The temporal scope of the analysis includes the time period during which project activities are conducted and the time period when existing and reasonably foreseeable lands and minerals activities may be anticipated. Cumulative analysis will only review the current boundaries for inventoried roadless areas, designated wilderness, and private lands because the analysis cannot anticipate changes in those boundaries in the future.

Geographic Scope

The geographic scope of the analysis is limited to the vicinity of proposed treatment units.

Affected Environment

This section presents a discussion of the affected environment for lands and minerals.

Mineral Activity

BLM oil and gas lease records and mining claim recordation data were examined online for all lands within the project area to determine the level of current mineral activity and whether any active unpatented mining claims or oil and gas leases occur within the project area.

There are currently no federal oil and gas leases issued within the project area.

There are a total of nine active unpatented mining claims within the project area that were located in the early 1990s. These are placer claims and nearly all of the mining claims are located within Sections 4, 5, and 6 of Township 5 South, Range 80 West, 6th P.M., within about one-half mile of Units 617, 618 and 619. Although economically significant placer mining in Colorado ended in 1951, many present-day prospectors recover small amounts of gold from gravels in alluvial deposits along streams and terraces just above streams (CGS 2003). The project area is not located within a notable placer mining area or gold mining district (CGS 2003). Faults and fracture zones in the Proterozoic rocks have been locally

prospected for copper, lead, zinc, and silver in thin veins; however, there are no known economic deposits, and extensive commercial and recreational activity make mineral development unlikely (Kellogg et al. 2003).

Non-Recreation Special Uses

There are numerous special use permits issued for non-recreation uses within the project area. These include sewer lines, a natural gas pipeline, various power line permits issued to the town of Minturn, a number of communication sites operated by different companies, a corral used by Spraddle Creek Ranch, Inc., a number of Colorado Department of Transportation permits, and several permits for water pipeline projects. The non-recreation uses are consistent with the need to accommodate an increased number of skiers and vacationers that use the lands within the project area during the winter and summer vacation seasons. The non-recreation permits are summarized in the *Project File*.

Land Status

There are roughly 15,000 acres of patented inholdings surrounded by Forest lands within the project area. Patents were granted for most of these lands beginning around 1890 and extending to roughly 1935. Virtually all of the Forest inholdings are located along the I-70 corridor.

Pending Land Exchange

The Vassar Land Exchange is currently in process and is reasonably likely to be completed within the next 18 to 24 months. Approximately 490 acres of land within WRNF is under review for exchange with lands located outside the project area. Although most of the land subject to the pending exchange falls within the project area, none of the acreage subject to the pending exchange is within any of the treatment units. Most of the acreage subject to the pending exchange is located in Sections 2 and 3 of Township 5 South, Range 82 West, 6th P.M.

Rights-of-Way

The Forest Service has existing authorized access to all proposed treatment units.

Landlines

Boundaries of designated wildernesses, inventoried roadless areas, and NFS/private lands that could be affected by the proposed project have been identified. The lengths of boundaries that could require landline location surveys in order to accurately locate proposed treatment units are shown in **Table 3–60**.

Table 3–60 Potentially Affected Boundaries in the Project Area

Potentially Affected Boundary	Potentially Affected Length (miles)
Eagles Nest Wilderness	1.9
Holy Cross Wilderness	0.3
Buffer Mountain Inventoried Roadless Area	0.3
Game Creek Inventoried Roadless Area	2.9
Corral Creek Inventoried Roadless Area	2.8
Meadow Mountain B Inventoried Roadless Area	0.3
Spraddle Creek B Inventoried Roadless Area	1.1
NFS/Private	5.6

Environmental Effects

Direct and Indirect Effects by Alternative

Alternative A - No Action

Under the No Action alternative, there would be no change to existing special use authorizations and private property landlines. However, under current forest conditions wildland fires could ignite in the project area or burn into the area. Landline locations can be lost when historic markers or fence lines are destroyed by wildland fires. Not all National Forest boundaries, wilderness areas, or inventoried roadless area boundaries in the project area have been surveyed and posted on the ground, and the effort to do so would be impacted by the loss of existing landline locations in wildland fires. The ability of the Forest Service to protect historic markers and fence lines from destruction by wildland fires would be hampered by fuel loading in places where landline locations have been established. The establishment of landline locations that are adequately tied to existing monuments and markers can be difficult and slow in heavy fuels.

Alternative B

The effects of wildland fire under Alternative B would be similar to Alternative A, but reduced fuel loads under Alternative B may lessen the severity or extent of burns, reducing the effects on landline locations. Proposed treatment of lodgepole pine, aspen, and shrublands under Alternative B could have an impact on structures and operations occurring on NF administered lands that have been authorized by the Forest Service. The proposed treatments would occur only on federal lands. To avoid trespass onto adjacent private lands, affected landline boundaries must be surveyed and posted.

A limited number of active placer mining claims are located within one-half mile of Units 618 and 619, where cutting of dead trees and pile burning would occur. Project implementation under Alternative B would include contacting the affected mining claimants and inviting them to identify their claim corners, discoveries, and other workings to the Forest Service. These features can then be avoided when trees are cut and protected during pile burning associated with the project.

Alternative B may have a limited impact on certain existing non-recreation special uses within the project area, such as power lines or pipelines, if the specific use crosses into one or more of the treatment units. During site-specific project design, a limited number of non-recreation special use permits would need to be reviewed to determine if the treatment unit would affect an authorized use or occupancy. Mitigation measures would be developed to protect authorized uses that would be affected by the project. Alternative B would be implemented only on federal lands.

Where the boundaries of treatment units are adjacent to private lands, designated wilderness, or inventoried roadless areas, the affected landline boundaries would need to be surveyed to ensure that implementation of the project would not trespass onto adjoining private lands. An estimated 15 miles of landline locations could require survey.

Alternative C

The effects on lands and minerals activities under Alternative C would not be expected to vary from those described above for Alternative B.

Alternative D

The effects on lands and minerals activities under Alternative D would not be expected to vary from those described above for Alternative B.

Cumulative Effects by Alternative

Alternative A - No Action

None of the past or ongoing activities in the project area would have a cumulative effect on mining claims or special use authorizations on NF administered lands or adjoining private lands, so long as the impacted boundary lines are surveyed.

Alternative B

None of the proposed treatments, past or ongoing activities, or reasonably foreseeable future actions would have a cumulative effect on mining claims or special use authorizations on NF administered lands in the project area or on adjoining private lands, so long as the impacted boundary lines are surveyed. Prescribed burns would be planned to minimize effects on nearby residents, authorized uses, and boundary markers, and would be conducted during times when atmospheric conditions would facilitate control of the burn and dispersal of smoke.

Alternative C

The cumulative effects for Alternative C would not be expected to vary from those described above for Alternative B.

Alternative D

The cumulative effects for Alternative D would not be expected to vary from those described above for Alternative B.

Forest Plan Consistency

All alternatives are in compliance with the lands and minerals management guidance contained in the Forest Plan and are consistent with existing regulatory requirements (Clean Water Act, Clean Air Act, ESA, NFMA, NEPA, the Forest Service Manual [FSM], State Law, and county planning area objectives).

Irreversible and Irretrievable Commitments

No irreversible or irretrievable commitment of land or mineral resources or special uses that are authorized under existing non-recreation special use permits would occur as a result of the implementation of the VVFH project.

3.4.3 Recreation Resources

Resource Description

Recreational activities are a highly visible use of the project area. Both residents and tourists rely on the WRNF as a source of recreational opportunities and could be affected by closures in popular areas, changes in recreation opportunities, or a reduction in the quality of recreation experiences caused by vegetation treatments, temporary roads, or burning. Proposed treatments also could affect characteristics of inventoried roadless areas or designated wildernesses. The local economy is highly dependent on recreation and tourism and could be affected by changes in recreation resources.

Indicators

- Effects on characteristics of inventoried roadless areas
- Treatments in inventoried roadless areas, in acres
- Effects on characteristics of designated wildernesses
- Treatments in designated wilderness areas, in acres
- Effects on determining factors for Recreation Opportunity Spectrum (ROS) class – remoteness, degree of naturalness, managerial setting (visitor controls), and social setting as the change in determining factor or ROS, summer or winter, in acres
- Displacement of recreation activities as miles temporarily closed
- Effects on recreational use of roads, trails, and other facilities
- Effects on existing recreation facilities (campgrounds, trailheads, other facilities)
- Effects on recreation special uses

Relevant Forest Plan Direction

The overall direction for managing recreation resources on the WRNF includes the national strategic goals to provide outdoor recreation opportunities in natural forest settings, promote access to recreation opportunities, and provide primitive types of experience in wilderness settings (Forest Plan, page AA-11). These goals are emphasized in the regional goal to provide for a range of recreational opportunities that respond to the needs of forest customers and local communities (Forest Plan, page 1-1).

Forest-wide objectives include improving the capability to provide diverse, high quality outdoor recreation opportunities, and managing wilderness so that changes are primarily a consequence of natural forces or within the range of natural variability and succession (Forest Plan, page 1-10). Forest-wide guidelines for recreation (Forest Plan, pages 2-31 and 2-32) apply to all areas of the Forest and include designing and implementing management activities that are consistent with the ROS User's Guide for the adopted summer and winter ROS classes. Forest-wide standards and guidelines are also provided for: Wilderness Resources (Forest Plan, page 2-34 and 2-35) and Roadless Areas (Forest Plan, page 2-40), which emphasize the long-term maintenance of roadless characteristics, the protection of natural processes, and habitat improvement.

Applicable guidelines for MA 5.41, MA 5.42, and MA 5.43 include restricting recreation activities that would disturb various wildlife habitats during specified periods. Applicable guidelines for MA 8.25 include minimizing impacts to recreation resources from resource management activities.

Use of prescribed fire in designated wildernesses is consistent with Forest Plan guidance for areas where unnatural fuel buildup has occurred and lightening-caused fires cannot be allowed to burn. Forest Plan

guidance incorporates use of prescribed fire, where appropriate, to meet wilderness management objectives.

In addition, FSM 2324 (USFS 1990), Recreation, Wilderness, and Related Resource Management, addresses the use of prescribed fire in designated wilderness. The objectives for fire management in wilderness are to: permit lightning caused fires to play, as nearly as possible, their natural ecological role; and, reduce, to an acceptable level, the risks and consequences of wildland fire within wilderness or escaping from wilderness. Forest Service managers may use prescribed fire in wilderness if the following conditions are met: the use of fuel treatments outside of wilderness is not sufficient to achieve fire management objectives within wilderness; an interdisciplinary team of resource specialists has evaluated and recommended the proposed use of prescribed fire; the interested public has been involved appropriately in the decision; and lightning-caused fires cannot be allowed to burn because they will pose serious threats to life and/or property within wilderness or to life, property, or natural resources outside wilderness.

Desired Condition

The desired condition for recreation requires balancing the needs to provide diverse recreation opportunities, facilitate user access, and protect resource values. The desired condition for recreation management is described below for each MA in the project area.

- 1.12 Primitive Wilderness – Recreation is managed to protect natural conditions, provide opportunities for primitive recreation, offer a moderately high degree of solitude, and incorporate a ROS of semi-primitive non-motorized or primitive year-round.
- 1.2 Recommended for Wilderness – Recreation is managed to protect wilderness characteristics. These areas are in the roadless area inventory. Opportunities for primitive recreation are provided, with moderate-to-high degrees of solitude available.
- 1.31 Backcountry Recreation, Non-Motorized – Recreation is managed for a variety of year-round non-motorized recreation opportunities in a natural or natural-appearing setting with a ROS of semi-primitive non-motorized year-round. No road building occurs in the area.
- 5.4 Forested Flora and Fauna Habitats – Recreation is managed to provide a mix of ecological and human needs. The ROS is semi-primitive motorized in the summer and semi-primitive non-motorized or semi-primitive motorized in the winter. This MA has a road and trail system.
- 5.41 Deer and Elk Winter Range – Recreation is managed to provide adequate amounts of quality forage, cover, and solitude for deer, elk, and other species. This MA has a relatively undeveloped road systems and trails, and incorporates a ROS of semi-primitive non-motorized or semi-primitive motorized in the winter/spring and in the summer/fall. Winter vehicle use is restricted to designated routes and play areas unless authorized by special use permit or for emergency use. Recreation activities that would disturb deer and elk are restricted during winter and spring periods.
- 5.42 Bighorn Sheep Habitat – Recreation is managed to provide healthy plant communities for food and cover. Fire plans are developed in support of habitat improvement. The ROS is primitive, semi-primitive non-motorized, semi-primitive motorized, roaded natural, or rural year-round.
- 5.43 Elk Habitat – Recreation is managed to provide for low road densities and optimum forage and cover ratios. Non-motorized recreational opportunities are provided, including hiking, mountain biking, horseback riding, hunting, and cross-country skiing. Motorized opportunities are limited. The ROS is semi-primitive non-motorized or semi-primitive motorized year round.
- 7.1 Intermix - Both motorized and non-motorized recreation activities are provided in MA 7.1, where the interface between NFS lands and other lands occurs, and a ROS of semi-primitive non-motorized, semi-primitive motorized, roaded natural, or rural applies year-round.

- 8.25 Ski Areas – Existing and Potential – Recreation is intensively managed to provide for downhill or cross-country skiing on existing sites and maintains selected inventoried sites for future skiing recreation opportunities. Both the Vail and Beaver Creek ski areas are located in MA 8.25. A ROS of rural applies year-round.
- 8.32 Utility Corridors - The ROS for designated utility corridors in MA 8.32 will be compatible with surrounding areas.

Temporal Scope

Short-term impacts to recreation resources in the project area are anticipated to occur for the duration of proposed activities. Long-term impacts to the recreation resources are only expected if proposed vegetation treatments are not implemented or are not successful, and wildland fires render the area inaccessible to recreationists.

Geographical Scope

The area analyzed for recreation resources is the project area.

Affected Environment

This section provides an overview of the condition of recreation resources within the project area, including a discussion of ROS, roadless areas, wilderness areas, developed recreation, trails and dispersed recreation, recreation special uses, and winter sports. More detailed information can be found in the *Project File*.

The Vail Valley provides a world-class recreational setting, particularly for skiing in the Vail and Beaver Creek ski areas. Within the project area, 19 percent of the lands are privately owned, 1 percent are owned by the State of Colorado, and 80 percent are NFS lands. Private lands are concentrated along the I-70 corridor. As a result, management of recreation activities dominates forest management activities in the project area.

Most of the recreational use in the project area is dispersed, with relatively few developed recreational opportunities. Recreational activities include skiing, hunting, horseback riding, camping, fishing, sight-seeing, picnicking, mountain biking, hiking, backpacking, cross-country skiing, snowshoeing, four-wheel driving, and snowmobiling. Winter recreation attracts the most visitors to the area, particularly skiing in the Vail and Beaver Creek ski areas. Developed recreation in the project area includes the two ski areas and two campgrounds.

Recreation Opportunity Spectrum

ROS classes have been adopted for all NFS lands within the project area in accordance with Forest Plan guidance. ROS is a system developed by the Forest Service that classifies recreation opportunities according to their physical, social, and managerial characteristics. The ROS classes within the project area include: Primitive, Semi-Primitive Non-Motorized, Semi-Primitive Motorized, Roaded Natural, and Rural. Each ROS setting, from least to most developed, is described below:

- Pristine – An area that is characterized by essentially pristine biophysical conditions and a high degree of remoteness for both wildlife and humans, with no perceptible evidence of past human use. Interaction between users is very low. All resource management activities are integrated so that natural biological processes are not adversely or artificially changed over time by human use. Pristine is a subclass of Primitive, as used in wilderness management.

- Primitive - An area that is characterized by an essentially unmodified natural environment of fairly large size. Interaction between users is very low and evidence of other users is minimal. The area is managed to be essentially free of evidence of human-induced restrictions and controls. Motorized access is not permitted.
- Semi-Primitive Non-Motorized - A natural, or natural appearing environment of moderate to large size. The concentration of users is low, but there is often evidence of other users. No roads are present.
- Semi-Primitive Motorized - A natural, or natural appearing environment of moderate to large size. Interaction between users in this setting is low, but there is often evidence of other users. Local roads used for other resource management activities may be present.
- Roaded Natural - A natural, or natural appearing environment of moderate size with moderate evidence of the sights and sounds of humans. Such evidence usually harmonizes with the natural environment. Interaction between users may be moderate to high, with evidence of other users prevalent. Motorized use is allowed.
- Roaded Modified - An area characterized by substantially modified environments except for campsites. Roads, landings, slash and debris may be strongly dominant from within yet remain subordinate from distant sensitive roads and highways. Interaction between users and evidence of others may be moderate on roads, but there is little evidence of others or interaction at campsites. The area is managed so that there are few on-site controls except for gated roads. Conventional motorized use is allowed and incorporated into construction standards and design of facilities.
- Rural - An area characterized by a substantially modified natural environment. The sights and sounds of humans are readily evident, and the interaction between users is often moderate to high. A considerable number of facilities are designed for use by a large number of people. Facilities for intensified motorized use and parking areas are available.

Separate ROS classes have been adopted for winter and summer within the project area. ROS classes adopted for summer are shown in **Figure 3–4** and ROS classes adopted for winter are shown in **Figure 3–5**. The percentage of NFS lands in the project area in each ROS class is presented in **Table 3–61**.

Table 3–61 ROS Class for National Forest Lands within the Project Area (percentage)

ROS Class	Winter	Summer
Pristine	3	3
Primitive	5	4
Semi-Primitive Non-Motorized	49	28
Semi-Primitive Motorized	5	29
Roaded Natural	2	2
Roaded Modified	2	0
Rural	13	13

In summer, the majority of the project area has an ROS class of Semi-Primitive Non-Motorized or Semi-Primitive Motorized. The Eagles Nest Wilderness, Holy Cross Wilderness, and Spraddle Creek area (recommended wilderness) have an ROS class of Pristine or Primitive. Most of the inventoried roadless areas (Buffer Mountain, Meadow Mountain B, Spraddle Creek B, most of Corral Creek, part of Game Creek, and part of Meadow Mountain A) have an ROS class of Semi-Primitive Non-Motorized. The part of the Meadow Mountain A and Game Creek roadless areas adjacent to the ski resorts have an ROS class of Rural. A small portion of the Corral Creek roadless area at the Gore Creek campground also has an ROS class of Rural. Spraddle Creek A roadless area is adjacent to the Eagles Nest Wilderness and has an ROS class of Primitive. The Vail and Beaver Creek ski areas have an ROS class of Rural.

Figure 3–4 ROS Classes Adopted for Summer

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Figure 3–5 ROS Classes Adopted for Winter

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In winter, the majority of the project area has an ROS class of Semi-Primitive Non-Motorized. The wilderness and recommended wilderness areas have an ROS class of Pristine, Primitive, or Semi-Primitive Non-Motorized. Most of the inventoried roadless areas (Buffer Mountain, Corral Creek, Meadow Mountain B, Spraddle Creek A, Spraddle Creek B, part of Game Creek, and part of Meadow Mountain A) have an ROS class of Semi-Primitive Motorized or Semi-Primitive Non-Motorized. The part of the Meadow Mountain A and Game Creek roadless areas adjacent to the ski resorts have an ROS class of Rural. The Vail and Beaver Creek ski areas have an ROS class of Rural.

Inventoried Roadless Areas

There are approximately 640,000 acres of inventoried roadless areas on the WRNF. Areas that are undeveloped or roadless in nature can serve a variety of purposes depending on what is regarded as most appropriate for the site. They can be managed as research natural areas or special interest areas, used for resource production or to provide non-motorized recreation, or, if suitable, recommended as wilderness (Forest Plan FEIS, page 3-523).

Forest-wide guidelines direct that inventoried roadless areas should be managed to emphasize long-term maintenance of roadless area characteristics (Forest Plan, page 2-40). Roadless area characteristics include: soil, water, and air resources; municipal watersheds; biodiversity; habitat for threatened, endangered, proposed, candidate, and sensitive species and for those species dependent on large, undisturbed areas of land; recreation opportunities in the primitive, semi-primitive non-motorized, and semi-primitive motorized classes; reference landscapes; scenic integrity; traditional cultural properties; sacred sites; and other unique characteristics. Forest-wide guidelines for roadless areas also support the improvement of habitat for threatened, endangered, proposed, or sensitive species, and the maintenance and restoration of roadless area ecosystems to reduce the potential for wildland fire effects and threat of insect or disease epidemics (Forest Plan, page 2-40).

The seven inventoried roadless areas found within the project area are shown in **Figure 3–6**. Of these seven inventoried roadless areas, four could contain treatment units; these are listed below in **Table 3–62**.

Table 3–62 Inventoried Roadless Areas and Treatment Units

Roadless Area Number	Roadless Area Name	Treatment Unit(s)[1]
33	Buffer Mountain	301, 302, 303, 305, 306, 309, 310, 620
37	Corral Creek	515
39	Game Creek	201, 202, 203, 204, 205, 206, 207, 208, 209, 313
29B	Spraddle Creek B	618, 619

[1] Treatment units in inventoried roadless areas may contain prescribed fire or mechanical fuels treatment but would not have any road construction.

Trails that lead into inventoried roadless areas are listed in **Table 3–63**. Roads (79 miles) and trails (93 miles) within the project area are shown on **Figure 3–6**. During hunting season (late August to November), hunting occurs on- and off-trail throughout all of these areas.

Table 3–63 Trail Access to Inventoried Roadless Areas

Trail Number	Name	Level of Use (Snow-free)	Level of Use (Snow)
1896	North Vail Trail	High	Moderate
2012	Pitkin Creek	High	Moderate
2014	Deluge Creek	High	Moderate
2015	Gore Creek	High	Moderate
2130	Game Creek	Low	Medium
2136	Son of Middle Creek	Moderate	Low
2111	Buffer Creek	Moderate	Low
2110	Buffer Mountain	Moderate	Low
Non-system	Matterhorn	Moderate	Moderate
2107	Nottigham Ridge	Moderate	Low
2106	Buck Creek	Moderate	Low
Non-system	Swift Gulch	Moderate	Low

Wilderness Areas

The project area includes the southwestern portion of the Eagles Nest Wilderness, and is adjacent to the Holy Cross Wilderness. The Eagles Nest Wilderness was established by Congress in 1976. It contains 133,496 acres and is located along the crest of the Gore Range Mountains, directly north of Vail Pass. The Holy Cross Wilderness was established by Congress in 1980. It contains 123,400 acres on both the White River and San Isabel National Forests.

There are a number of trails that lead into designated wildernesses that are within or near proposed treatment areas. These trails are shown on and listed in **Table 3–64**. Because of the proximity to the town of Vail, these trails receive high use in the summer and moderate use during the rest of the year. Their use is non-motorized and non-mechanized. During hunting season (late August to November), hunting occurs on- and off-trail throughout these areas.

Table 3–64 Trails In and Near Wilderness Areas

Wilderness Area	Trail Number	Trail Name
Eagles Nest	2012	Pitkin Creek
Eagles Nest	2013	Bighorn Creek
Eagles Nest	2014	Deluge Creek
Eagles Nest	2015	Gore Creek
Holy Cross	2006	Cross Creek
Holy Cross	2127	Grouse Lake
Holy Cross	2128	Martin Creek
Holy Cross	2129	West Grouse Creek

Developed Recreation

There is relatively little developed recreation in the project area outside the Beaver Creek and Vail ski areas (discussed below). The Gore Creek campground is located adjacent to the Eagles Nest Wilderness, 6 miles east of Vail on the I-70 frontage road (Public Lands Information Center 2004). The facilities include 25 designated campsites, RV sites, drinking water, and restrooms.

Figure 3–6 Roads and Trails

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Trails and Dispersed Recreation

Trails within the project area are used for hiking, horseback riding, and mountain biking. Many areas are closed to travel between May 15 and June 20 for elk calving. Some are closed from December to July to meet elk habitat objectives. Trail and dispersed recreation use in the project area occurs primarily in Stone and Whisky Creeks; Grouse Creek; Martin Creek; and Spraddle, Middle, and Buffer Creek drainages. Each of these areas is discussed below. Trail use in wilderness and inventoried roadless areas was discussed in the previous section.

There are four trails in the Stone and Whiskey Creek area used for hiking, horseback riding, and mountain biking; they are closed to motorized use. The area is used for hunting big game between late August and November. The Stone Creek and Whiskey Creek trails are used year-round by local residents. There have been problems with illegal snowmobile use, illegal trespass onto the Eagle-Vail Golf course, trespass onto private property, and noncompliance with seasonal trail closures in the area. Units 101 through 106 are proposed in this area.

The Grouse Creek drainage is adjacent to the Holy Cross Wilderness. There are three trails in the Grouse Creek area used for hiking, horseback riding, and mountain biking outside the wilderness boundary. Trails are closed to motorized use except for over-snow travel. The area is used for hunting big game between late August and November. During winter, the area is heavily used by snowmobiles, cross country skiers, and snowshoers. Units 115 through 126 are proposed for treatment in this area.

Two trails in the Martin Creek area are used for hiking and horseback riding; they are closed to motorized use except over-snow travel. Over-snow vehicle use is restricted to designated routes and play areas. The area is used for hunting big game between late August and November. There have been significant issues with illegally constructed trails, motorized use, and vandalism in the area. Units 127 through 129 are proposed for treatment in this area.

The Spraddle, Middle, and Buffer Creek drainages are located north of I-70 and adjacent to the Eagles Nest Wilderness. There are seven trails in the area used for hiking, horseback riding, and mountain biking outside the wilderness area. Trails are closed to motorized use. The area is used for hunting big game between late August and November. During winter, the area is also used by cross country skiers and snowshoers. The Davos trail is used as the access road for a radio tower. Son of Middle Creek trail is also used as a stock driveway for sheep. Units 617 through 620 are proposed for treatment in this area.

Additionally, two trails in the Nottingham Gulch drainage are used for hiking, mountain biking, dirt biking, and ATV riding. In the past 3 years, there has been a significant increase in illegal motorized trail development in the area. Units 301, 302, 303, 305, 306, 309, and 310 are proposed for treatment in this area.

Trails, their level of use, and seasonal restrictions are shown in **Table 3–65**.

Table 3–65 Trail Use and Seasonal Restrictions

Trail #	Name	Level of Use (Snow-free)	Level of Use (Snow)	Seasonal Restrictions
2349	Paulie's Plunge/Stone Creek	Moderate	Low	Closed to all use 5/1-6/30
2350	Paulie's Sister	Moderate	Low	Closed to all use 5/1-6/30
2347	Eastern Hillside	Low	Low	Closed to all use 12/1-7/1
2348	Whiskey Creek	Moderate	Low	Closed to all use 12/1-7/1
2129	West Grouse Creek	High	High	None
2127	Grouse Lake	High	High	None
2010	Grouse Connector	Moderate	High	None
2128	Martin Creek	Low	Low	None
N/A	HX Compound Trail[1]	Low	Low	None
1880	Spraddle Creek	Low	Low	None
2136	Son of Middle Creek	Moderate	Low	None
N/A	Tenth Mountain Division Winter Eiseman Hut Trail	None	Moderate	None
1896	North Vail Trail	High	Moderate	Closed from 4/15-6/15
2111	Buffer Creek	Moderate	Low	None
781A	Davos	Moderate	Moderate	None
2106	Buck Creek	Moderate	Low	None
2107	Nottingham Ridge	Moderate	Low	None

[1] Not displayed on Figure 3-6
N/A - Not applicable

Recreation Special Uses

There are numerous special use permits for recreation throughout the project area. Activities include hiking, backpacking, camping, rock climbing, horseback riding, fishing, mountaineering, cross-country skiing, nordic skiing, ice climbing, snowshoeing, scientific study, mountain biking, llama trekking, hunting, snowcat tours, snowmobile tours, and jeep tours. The special use permits are summarized in the project file.

Winter Sports, Including Ski Areas

The Vail and Beaver Creek ski resorts are located within the project area. The ski resorts draw large numbers of visitors to the project area during winter and spring months. The number of skier visits at these two resorts has increased 45 percent in the last 15 years. During the 2000-2001 ski season, there were 1.6 million visitors to Vail and 675,000 to Beaver Creek (Ski Press Magazine 2001). The access portals to each ski area are at or near capacity. Construction of a new gondola from Avon to Beaver Creek Village may improve public access to the mountain and provide a public attraction for winter and summer visitors.

There are several areas within the permit boundary for the Vail ski resort that have proposed treatments within or near them. The far eastern portion of Unit 313 lies within the ski area permit boundary. This area does not receive much use during the winter from skiers. However, a hiking trail located on the north side of Game Creek, at the bottom of Unit 313, is used by skiers and snowshoers. The Game Creek drainage also has the potential to serve as an aerial transportation corridor linking Minturn with Vail Mountain in the vicinity of the vacant railroad property.

There are three trails that begin within the Vail ski resort and end outside of it: Cougar Ridge; Grand Traverse; and Matterhorn. Three trails begin within the Beaver Creek ski resort and end outside of it: Paulie's Plunge; Paulie's Sister; and Eastern Hillside. **Table 3–66** shows trail use near ski areas.

Table 3–66 Trail Use Near Ski Areas

Trail Number	Trail Name	Level of Use (Snow-free)	Level of Use (Snow)
N/A	Cougar Ridge	Moderate	Moderate
N/A	Grand Traverse	Moderate	(within ski trails)
N/A	Matterhorn	Moderate	Low
2349	Paulie's Plunge/Stone Creek	Moderate	Low
2350	Paulie's Sister	Moderate	Low
2347	Eastern Hillside	Low	Low

N/A – Not applicable

Units 101 through 106 would be located northeast of Beaver Creek ski resort. These units are outside the ski area permit boundary but are located within a drainage that is frequently skied and snowshoed.

Environmental Effects

Direct and Indirect Effects by Alternative

Vegetation management activities and associated road construction can impact recreation activities by altering the physical setting and visual quality of the recreation experience, by changing access opportunities, by directly disrupting recreation activities, and by affecting the ROS class characteristics. The concern regarding the quality of scenery is high for recreationists that use developed sites and those engaged in dispersed activities such as hiking or sightseeing. Because of the concentration of developed recreational sites and adjacent private land development, little hunting occurs within the project area. Visual impacts from the VVFH project are evaluated in the Scenic Resources section of this chapter.

Mitigation of impacts to recreational opportunities identified from any of the alternatives would primarily address short-term impacts from treatment activities. The majority of these impacts are related to the impact on the scenic resources of the analysis area, and any potential changes in access opportunities. The Forest Service has committed to a variety of measures designed to protect the area's resources. Resource protection measures proposed for scenic resources, transportation, erosion control, vegetation, and wildlife also mitigate impacts to recreational opportunities and are described in **Appendix D**.

Alternative A – No Action

Under Alternative A, the No Action alternative, recreation management in the project area would remain nearly the same. There would be no change in the determining factors for ROS class, no addition or closure of roads or trails. Most lightning caused fires in Eagles Nest Wilderness and the inventoried roadless areas would continue to be suppressed due to hazards posed to nearby development. The wildland fire hazard within the project area would continue to grow. Recreation special uses and ski area operations would continue without interruption.

Alternative B

Recreation Opportunity Spectrum

Over the long-term under Alternative B, the recreation experience would be enhanced in the project area with the improvement of forest health resulting from implementation of the VVFH project. However, in the short-term, vegetation treatments, fuel treatments and prescribed burns would have the following effects on the ROS and ROS-determining factors.

Primitive – Prescribed burn fuels treatments in Units 411, 412, 514, and 515 would affect the unmodified natural environment during project implementation.

Semi-Primitive Non-Motorized – The majority of fuel treatments would be implemented during the snow-free season in this ROS class. Units 101 through 106, 115 through 129, 201 through 214, 301, 302, 303, 305, 306, 309, 310, 618, 619, and part of Unit 313 are located in the semi-primitive non-motorized ROS class during the summer. Temporary roads and vegetation treatments would affect the natural-appearing environment and introduce vehicles along temporary roads. Project activities could also increase the interaction between users.

Rural – One prescribed burn treatment area, Unit 313, occurs partially within the rural ROS Class near the Vail ski resort. The treatment unit would not affect the characteristics of this ROS class.

Inventoried Roadless Areas

Four of the seven inventoried roadless areas within the project boundary contain prescribed burn or fuels treatment units (**Table 3–67**). No road construction or commercial timber harvest is proposed in these areas.

Cutting and leaving trees in aspen and fuels treatment units would detract from the scenic integrity and degree of naturalness of affected inventoried roadless areas. Without affecting recreation activities, downed trees would provide habitat for threatened, endangered, proposed, candidate, and sensitive species.

Prescribed burn fuel treatments are expected to have a short-term effect on the roadless area characteristics of inventoried roadless areas. Recreation activities and scenic integrity would be degraded during project implementation. However, over the long-term, roadless area characteristics would be enhanced as the overall health of the forest is improved. Biodiversity and habitat would benefit from improved forest conditions.

Trails that lead into inventoried roadless areas were identified in **Table 3–63**. The trails identified in **Table 3–67** would experience temporary closures during project implementation.

Table 3–67 Trails in Inventoried Roadless Areas Affected During Project Activities

Trail Name	Trail Number	Treatment Unit(s)
Gore Creek	2015.1	412, 515
Son of Middle Creek	2136.1	618
North Valley Trail	1896.1 and 1896.3	201, 313, 617, 618, 619, 620
Game Creek	2130.1	313
Swift	N2106.1A	306
Game Creek	2130.1	313

Designated Wilderness

There are two treatment units within the Eagles Nest Wilderness, Units 411 and 412, and two adjacent treatment units, Units 514 and 515, lie outside the wilderness boundary. Broadcast burning in the Eagles Nest Wilderness would encompass 520 acres, and 230 adjacent non-wilderness acres would be treated with both pile burning and broadcast burning. During fuels treatment, there would be increased activity and visible smoke effects in the Eagles Nest Wilderness. Broadcast burning would blacken the burned area for about 4 to 6 weeks, causing a short-term visual impact. Treatment of fuels would allow the Forest Service to manage future natural ignitions for resource benefit such that fire may play a more natural role in the ecosystem.

Prescribed burn fuel treatments are expected to have a short-term effect on the wilderness characteristics. The natural appearance and solitude of the area would be degraded during project implementation. However, over the long-term, wilderness characteristics, particularly the natural appearance, would be enhanced as the overall health of the forest is improved.

There are no fuel treatments in or adjacent to the Holy Cross Wilderness. However, some trails leading into the Holy Cross Wilderness and the Eagles Nest Wilderness would be closed during project activities. The affected trails are described below and listed in **Table 3–68**.

Table 3–68 Trails into Designated Wildernesses Affected During Project Activities

Trail Name	Trail Number	Treatment Unit(s)
Bighorn	2013.1	411, 514
Gore Creek	2015.1	412, 515
Martin Creek	2128.1	128
West Grouse Creek	2129.1	117, 118, 119
Grouse Lake	2127.1	121, 122

Developed Recreation

The Gore Creek campground would not be affected by the proposed project. Unit 412 would be located along the east side of Gore Creek Campground. Campground activities would be temporarily disrupted by the sights and sounds of prescribed burn and fuel treatment activities. However, fuels treatment would reduce the potential for wildland fire, which would cause considerably greater disruptions to recreational activities and contribute to long-term adverse impacts to the scenic quality of the landscape.

Trails and Dispersed Recreation

Trail opportunities would be affected in the project area during project implementation. **Table 3–69** summarizes the trails that would likely be affected during fuel treatment activities. There would be some short-term displacement of dispersed recreation within and adjacent to treatment units. Most limitations or closures would last for several days to a week.

Project activities would affect the recreation experience for short periods over the duration of project implementation, up to several years. Machinery used for thinning and harvesting would increase noise and dust in the treatment units and the immediate surroundings. Blackened vegetation and smoke from prescribed burns would also detract from the recreation experience. Hunters may be affected by the potential displacement of game animals by treatment activities. Recreationists could also be affected by safety precautions from both mechanical and fire treatment activities. Temporary roads could increase legal and illegal recreation opportunities until they are closed and rehabilitated.

Under Alternative B, 1.1 miles of the Stone Creek trail would be widened to 20 feet to accommodate motorized timber hauling and road maintenance standards. This trail would be closed for one logging season (spring through fall) during lodgepole pine treatment activities in Units 101 and 102. The trail would be restored after its use for log hauling is completed. This trail receives a moderate level of use in the snow-free season. Its use for timber hauling would degrade the recreation experience along the trail for several months and temporarily could displace recreationists. The quality of the recreation experience along this trail would be significantly degraded until timber hauling is complete, and the trail is rehabilitated.

Table 3–69 Trails Affected During Project Activities

Trail Name	Trail Number	Treatment Unit(s)
Paulie's Plunge/Stone Creek	2349.1	101, 102, 214; widened for timber hauling
Whiskey Creek	2348.1	103, 104
West Grouse Creek	2129.1	117, 118, 119
Grouse Lake	2127.1	121, 122
Martin Creek	2128.1	128
Son of Middle Creek	2136.1	618
North Valley Trail	1896.1 and 1896.3	201, 313, 617, 618, 619, 620
Buck Creek	2106	306

Recreation Special Uses

A number of special use permit activities could be restricted due to temporary trail closures. These temporary closures might occur over several days to a week. A detailed list of special use permits and their permitted areas is available in the *Project File*. None of the special use permits is limited to a trail or trails that could be closed temporarily during project activities. Special use permit holders would be displaced to other areas within their permitted area during temporary trail closures.

Winter Sports, Including Ski Areas

Recreation activities at the Vail ski resort would be minimally affected during non-winter months by the proposed project. The easternmost portion of Unit 313 lies within the ski area permit boundary. During burning, smoke would be visible to hikers and mountain bikers at the Vail ski resort. In addition, the Game Creek trail is adjacent to this unit and would be temporarily closed during burning activities (**Table 3–70**).

Units 101 through 106 are located east of Beaver Creek ski resort. The quality of the recreation experience along the Paulie's Plunge/Stone Creek trail that enters the resort would be degraded for up to several months. There would also be possible temporary displacement of recreationists until project activities are completed and the trail is rehabilitated.

Table 3–70 Trails Entering Ski Areas Likely Affected During Project Activities

Trail Name	Trail Number	Treatment Unit(s)
Paulie's Plunge/Stone Creek	2349.1	101, 102, 214
Game Creek	2130.1	313

There would be no treatment activities during winter months, so dispersed winter recreation would not be affected. Snow cover in treatment units would prevent the visual effects of vegetation management from affecting winter recreation.

Alternative C

The effects of Alternative C would be the same as Alternative B, with the following exceptions.

Recreation Opportunity Spectrum

Changes in the ROS determining factors when compared with Alternative B include:

Primitive – No broadcast burning would occur in Units 411 and 412, reducing the effects on the unmodified natural environment of the Primitive ROS Class area.

Semi-Primitive Non-Motorized – Under Alternative C, an additional 3,600 feet of temporary tractor haul road would be added above Units 101 and 102 in this ROS Class to avoid closure of the Stone Creek trail. Instead of broadcast burning, Units 301, 302, 303, 305, 306, 309, 310, 313, 514, and 515 would be treated with mechanical thinning and pile burning. This would increase the time required for project activities and the duration of mechanized equipment in these areas.

Rural –Unit 313 occurs partially within the rural ROS Class near the Vail ski resort. This unit would be treated with mechanical thinning and pile burning instead of broadcast burning. This would increase the time required for project activities and the use of mechanized equipment in the unit; however, the characteristics of this ROS class would not be affected.

Inventoried Roadless Areas

Mechanical thinning and pile burning would be conducted instead of broadcast burning in Units 301, 302, 303, 305, 306, 309, 310, and 313 in inventoried roadless areas. Mechanical thinning and pile burning are expected to have a longer-term effect on the characteristics of inventoried roadless areas. Characteristics related to recreation activities and scenic integrity would be degraded during project implementation, which would occur over a longer period of time. No roads would be constructed in these units. Treatments would be accomplished using hand tools.

Designated Wilderness

No broadcast burning would occur in Units 411 and 412 in the Eagles Nest Wilderness. This would reduce the short-term impacts of smoke and activity in this wilderness area. Most natural ignitions would continue to be suppressed and fire would not be allowed to play its natural role due to fuel loading and close proximity to development. Temporary trail closures into designated wildernesses would be the same as under Alternative B.

Trails and Dispersed Recreation

Temporary trail closures in the Buck Creek area, if needed, could occur over a longer period of time due to the duration of mechanized thinning and pile burning activities. Under Alternative C, the Stone Creek trail would not be used for timber hauling, allowing recreationists access to this trail.

Alternative D

The effects of Alternative D would be the same as those for Alternative B, with the following exceptions.

Recreation Opportunity Spectrum

Changes in the ROS determining factors when compared with Alternative B include:

Primitive – No broadcast burning would occur in Unit 411, reducing the effects on the unmodified natural environment of the Primitive ROS Class area.

Semi-Primitive Non-Motorized – In this alternative, Units 201, 203, 204, 205, 206, 207, 208, 209, 515 and 620, would be eliminated. This would reduce the effects of tree cutting, mechanized equipment, and pile burning within this ROS Class.

Inventoried Roadless Areas

Alternative D was designed to reduce the impacts from cutting trees in inventoried roadless areas. Under this alternative, no trees would be cut in inventoried roadless areas beyond the 200-foot interface between NFS and private lands. This would eliminate the aspen enhancement treatments in Units 201, 203, 204, 205, 206, 207, 208, 209, and 620. The acreage of Units 618 and 619 would be significantly reduced. As a result, this alternative would have the fewest short-term effects on characteristics of roadless areas. The untreated acres would be not affected by a reduction in recreation activities or decline in scenic integrity.

Designated Wilderness

Unit 412 would be eliminated, reducing broadcast burning acreage in the Eagles Nest Wilderness. This would reduce the short-term impacts of smoke and activity in this wilderness area. Where natural fuel buildup and wildland fire hazards outside the wilderness are not reduced, most natural ignitions will continue to be suppressed to minimize the threat to life and property outside of the wilderness. With the elimination of Units 412 and 515, the Gore Creek trail would not require temporary closure.

Trails and Dispersed Recreation

With the elimination of Units 201, 203, 204, 205, 206, 207, 208, 209, and 620, there would be relatively lower impact to recreationists when compared with Alternative B. The temporary trail closures identified for Alternative B would remain for all other treatment units.

Cumulative Effects by Alternative

Alternative A – No Action

Effects from past and ongoing activities on public and private lands and future activities on private lands within the project area would contribute to cumulative impacts on recreation resources in the project area. The impacts from urban development on private lands are evident and are likely to become more evident over time. The effects of prior and existing activities on NF administered lands in the project area are primarily related to roads, trails, past vegetation management projects described in the Vegetation section of this chapter, and recreation facilities, including Vail and Beaver Creek ski resorts. The number of skier visits at the two resorts has increased 45 percent in the last 15 years. Roads, trails, ski trails, and urban developments are contributing to relatively high levels of recreational use. The cumulative impact of all existing activities would result in increased visibility of treatment units from transportation routes, recreation areas, and residential areas, as developments and use increase over time. There would be no known cumulative effects on inventoried roadless areas or designated wildernesses.

The Vegetation section of this chapter identifies past timber activities in the project area. The cumulative effects of these activities on recreation would be small and short-lived, based on effective and

comprehensive implementation of design criteria described in **Appendix D**, implementation and maintenance of BMPs during treatment activities, and reclamation following activities.

Alternative B

The VVFH project would add to past and ongoing activities on NF administered lands described above under Alternative A – No Action. Effects from the proposed treatments would be localized in the vicinity of the treatment units due to the implementation of design criteria and BMPs that would reduce the effects on recreation. Reasonably foreseeable Forest Service management activities in the project area would not be expected to contribute to cumulative conditions that would not meet Forest Plan guidance. Past actions in the project area include timber harvest and other vegetation management activities, including associated access roads and log skids. Evidence of these activities is visible in some areas; however, there has been no impact on current levels of recreation from these past activities. There are no reasonably foreseeable actions planned that would add to impacts from past and proposed vegetation management activities.

Sanitation and salvage in areas where mortality from mountain pine beetle (MPB) is high, or possible re-entry after 10 years into the lodgepole pine treatment units where ladder fuels need treatment or not enough basal area was removed under Alternative B to effectively modify future MPB risk would not be expected to result in cumulative conditions that would exceed the project-only effects to recreation.

There are no existing or reasonably foreseeable temporary trail closures that would add to impacts from the proposed project. Additional cumulative impacts on trail use and the quality of the recreation experience along trails near treatment units would not be anticipated.

Alternative C

The cumulative effects for Alternative C would not be expected to vary from those described above for Alternative B.

Alternative D

The cumulative effects for Alternative D would not be expected to vary from those described above for Alternative B.

Forest Plan Consistency

All alternatives are in compliance with the recreation management guidance contained in the Forest Plan and are consistent with existing regulatory requirements (Clean Water Act, Clean Air Act, ESA, NFMA, NEPA, the Forest Service Manual, State Law, and county planning area objectives).

Irreversible and Irretrievable Effects

An irreversible or irretrievable commitment of resources would occur when resources would be consumed, committed, or lost as a result of the project. The commitment of resources would be irreversible if the project started a process (chemical, biological, or physical) that could not be stopped. As a result, the resource, its productivity, or its utility would be consumed, committed, or lost forever. Commitment of a resource would be considered irretrievable when the project would directly eliminate the resource, its productivity, or its utility for the life of the project and possibly beyond.

No irreversible or irretrievable effects on recreation resources would occur. Trail-related and backcountry opportunities would be temporarily affected during treatment activities. Once treatment has been completed, the landscape in treatment units would provide recreation settings similar to those that currently exist.

3.4.4 Transportation

Resource Description

Transportation analysis is used to minimize the impacts of development on NFS lands. Road- and traffic-related issues were specifically identified during project scoping. Project activities could affect transportation in the project area by impacting slope stability and landslides, cultural resources, and recreational use on trails.

Indicators

- Changes to the road transportation system
- Density of open travelways

Forest Plan Direction

The overall direction for managing transportation on the WRNF includes the national strategic goal to operate and maintain the Forest Development Transportation System in a manner that provides cost-effective support of resource management activities and safe travel for users of the system while protecting the environment, adjacent resources, and the public investment (Forest Plan, page AA-9). Forest-wide objectives include providing access to NFS lands and USDA Forest Service programs (Forest Plan, page 1-14). Forest-wide standards for travel system infrastructure (Forest Plan, page 2-36) include closing and rehabilitating temporary roads when no longer needed for project purposes. Forest-wide guidelines (Forest Plan, page 2-37) consider seasonal restrictions for travelways where appropriate, emphasize maintenance and reconstruction of the existing road and trail system to standard, consider road decommissioning where appropriate, emphasize public safety in the development and use of the travel system, provide for the design of roads to minimize visual and environmental impacts where possible, and provide for the application of public access restrictions for health, safety, and other considerations. Guidelines for MA 5.4 include that new roads and trails needed for management should be low-standard, single-purpose roads, and travelways open to motorized travel will not exceed an average travelway density of two miles per square mile. Guidelines for MA 5.43 include that travelways open to motorized travel will not exceed an average travelway density of one-half mile per square mile during periods designated for calving, migration, or other elk habitat use during winter or summer.

Desired Condition

The Forest Plan identifies no explicit desired condition for transportation; however, opportunities and constraints for the transportation system are addressed through the roads analysis process and travel management planning.

Roads analysis is a required component of the decision-making process for all Forest Service decisions that involve the road system on NF administered lands. The objective of roads analysis is to provide decision-makers with critical information necessary to develop road systems that are safe, responsive to public needs and desires, and in balance with available funding for the management actions needed.

Roads analysis is conducted in accordance with all applicable Forest Service policies and guidance documents, including Miscellaneous Report FS-643, *Roads Analysis: Informing Decisions about Managing the National Forest Transportation System* (USFS 1999b), Forest Service Manual (FSM) Interim Directive 7710-99-1 (which authorizes units to use, as appropriate, the roads analysis procedure described in FS-643 to assist land managers making major decisions about road management) and the Region 2 Supplement to Appendix 1 of FS-643 (USFS 2001), which provides guidance on the appropriate scale for roads analysis.

The WRNF completed a forest-scale roads analysis report in 2003 (USFS 2003d). The forest-scale roads analysis identifies pertinent ecological, social, and economic issues essential to making future decisions about the characteristics of the WRNF transportation system. These issues are used to identify road management opportunities that would improve characteristics of the forest road system to balance the benefits of access with road-associated environmental effects, road management costs, and the social interests of communities.

A project-level analysis is included in the *Project File*, and supplements the forest-scale roads analysis completed for the WRNF. It focuses on information needed to support management decisions about roads related to the VVFH project (USFS 2004).

The interpreted desired condition for transportation would be that changes made to the road transportation system during project activities revert back to the existing condition. Existing roads would be reconstructed and maintained to meet Forest Service design standards for the proposed uses, which are sensitive to the environment and create a sensible and manageable travel network for the desired uses in the project area. Potential temporary roads would be constructed for the proposed uses to meet Forest Service design standards, which are sensitive to the environment. After the lodgepole pine treatments are completed, the temporary roads would be reclaimed. No new permanent roads would be constructed. No road construction would occur in inventoried roadless areas.

Temporal Scope

The temporal scope evaluated includes the short-term impacts in the project area for the duration of proposed activities and long-term impacts in the project area after potential temporary roads are reclaimed and the project area reverts back to existing road transportation system condition.

Geographic Scope

The area of analysis for transportation is the transportation infrastructure in the project area that may be directly affected. Changes to the road transportation system apply to MAs 5.4 and 5.43, where lodgepole pine treatments would be accessed. Changes to the road transportation system in the remaining management areas within the project area are not proposed.

Affected Environment

This section provides an overview of the condition of transportation resources within the project area. Roads and trails within the project area are shown in **Figure 3–6**. Changes to the road transportation system would apply to MAs 5.4 and 5.43 near Minturn, where proposed lodgepole pine treatments would be accessed. **Table 3–71** summarizes the guidelines for density of open, motorized travelways in MAs 5.4 and 5.43 near Minturn. The existing conditions in MA 5.4 and MA 5.43 that would be affected by lodgepole pine treatment units meet the Forest Plan guidelines for density of open, motorized travelways.

Table 3–71 Density of Open Motorized Travelways in MAs 5.4 and 5.43 Near Minturn

Management Area	Current Density of Open Motorized Travelways (Miles per Square Mile)	Forest Plan Guideline for Density of Open Motorized Travelways
MA 5.4 Forested Flora and Fauna Habitats	0.7 mile of road per square mile	Not to exceed an average of 2 miles of motorized travelways per square mile[1]
MA 5.43 Elk Habitat	0 miles per square mile	Not to exceed ½ mile of motorized travelways during calving periods[2]

[1] Forest Plan, page 3-56
[2] Forest Plan, pages 3-61 to 3-69; calving restrictions apply from May 15 to June 20

Transportation Network

The main road corridors that cross the project area carry large volumes of traffic to access destinations within and outside of the project area. The I-70 corridor is one of the main east-west routes across the country, and is the most traveled corridor through the project area. The other main highways in the analysis area are U.S. 24 and U.S. 6. U.S. 24 is a scenic byway, designated the Top of the Rockies, and connects Minturn to Leadville. Eagle County classifies U.S. 24 as a minor arterial and U.S. 6 as a major collector (Eagle County 2004).

There are numerous local county roads located in unincorporated areas of Eagle County. The unincorporated areas in the project area, Wildridge, Mountain Star, and Eagle Vail, have a network of county-administered roads. The majority of county roads are located north of I-70 in the Buck Creek area. One county road would be used to access the project area. Eagle Bend county road connects U.S. 24 to Stone Creek Trail and potentially to Units 101 and 102 (Currie 2004a). County roads are in good condition and are maintained by the county. Roadways in unincorporated Eagle County function as Level of Service "C" roads (Eagle County, 2004).

There is one private road located in the project area. A Pack Trail/Jeep Trail is an unnamed private road that can be accessed off of U.S. 24 in Minturn. The Jeep Trail goes southwest through private land to a meadow and then climbs slightly to Unit 128. Near the north end of Unit 128 on the Jeep Trail, there is a private gate. Several homes are located south of the gate and several cabins are located farther south. From U.S. 24 to the gate, the Jeep Trail is a rock and gravel drivable road that is plowed and maintained by residents. Beyond the gate, the Jeep Trail becomes a gravel road that is drivable to a cabin site adjacent to the wilderness boundary. The road then becomes two-track to the Holy Cross Wilderness boundary (Currie 2004a). The Jeep Trail road would not be used to access the project area.

Traffic Flows and Volumes

Annual Average Daily Traffic (AADT) counts for the Colorado State Highway System were obtained from the Colorado Department of Transportation (CDOT). **Table 3–72** shows the counts for selected highway routes at chosen highway mileposts along I-70 and within the project area for 2002 and 2003. Traffic on I-70 during 2003 ranges from 15,836 AADT entering Vail at Dotsero from the west to 26,662 at the Avon Interchange and 18,897 AADT at the Vail East Interchange. The change in AADTs at each end of the project area indicates that the project area is the destination for a large volume of traffic on the highway.

Table 3–72 Average Annual Daily Traffic Counts for I-70 within the Project Area

Route	Ref Pt	End Ref Pt	Length (Miles)	2002 Annual Average Daily Traffic	2003 Annual Average Daily Traffic	2002 Percent Trucks	2003 Percent Trucks	Segment Description
070A	134.053	139.533	5.455	16,171	15,836	18	18.5	Dotsero - East Interchange Rd N and S To Frontage Rds Overpass Strs F-08-U EB And F-08-V WB
070A	139.533	146.648	7.004	17,902	18,149	18	17.8	Gypsum Interchange Sh 6 Se Rd N Underpass Str F-09-J
070A	146.648	156.547	9.899	20,890	22,366	14	14.4	Eagle Interchange I-70 Eagle Business Spur SH 70 S Rd N Underpass Str F-09-AB
070A	162.782	166.623	3.824	32,464	29,499	10	9.9	Edwards Interchange Edwards Rest Area I-70 Edwards Business Spur SH 70 S Rd N to Frontage Rd Overpass Strs F-10-R EB And F-10-P WB
070A	166.623	171.105	4.595	24,478	26,662	9	9.2	Avon Interchange I-70 Avon Business Spur SH 70 S Rd N to Frontage Rd (Nottingham Rd) Overpass Strs F-10-T EB And F-10-S WB
070A	173.319	176.031	2.682	27,271	20,775	9	8.6	Vail West Interchange Rd N and S To Frontage Rds Chamonix Rd N Overpass Strs F-11-R EB and F-11-P WB
070A	176.031	179.869	3.816	19,963	18,897	10	10.3	Vail Interchange Rd N to Frontage Rd Vail Rd S Overpass Strs F-11-0 EB And F-11-N WB
Total			37.275	22,734	21,741	13	13	

Source: CDOT 2004a

Table 3–73 shows the AADT counts for U.S. 24 from the I-70 and U.S. 24 interchange to Minturn Road for 2002 and 2003. Traffic on U.S. 24 during 2003 ranges from 7,348 AADT at the I-70 and U.S. 24 interchange to 6,358 AADT at Minturn Road.

Table 3–73 Average Annual Daily Traffic Counts for U.S. 24 within the Project Area

Route	Ref Pt	End Ref Pt	Length (Miles)	2002 Annual Average Daily Traffic	2003 Annual Average Daily Traffic	2002 Percent Trucks	2003 Percent Trucks	Segment Description
024A	143.4	145.179	1.77	8,112	7,348	4	4.3	I-70 Interchange (Minturn/Leadville) SH 70 NE and SW Underpass Str F-11-AD End Overlapping Non-Chargeable Section Begin SH and US 24
024A	145.179	145.537	0.358	6,903	6,358	5	5.2	Rd NE(Minturn Rd)
Total			2.128	7,507.5	6,853	4.5	4.75	

Source: CDOT 2004a

Existing Forest Service Road Classifications, Road Conditions, and Level of Service

There are approximately 79 miles of jurisdictional Forest Service roads within the project area based on existing GIS data in the *Project File*. The existing roads that are located where changes to the road transportation system would occur are located in MAs 5.4 and 5.43 in the Meadow Mountain /Grouse Creek and Stone and Whiskey Creek geographic areas. Historically, these roads were used for farming, ranching, and ski area operations (USFS 2003b). National Forest System Roads (NFSRs) 733.1, 748.1, and 749.1, are authorized for administrative use only, and are not open for public motorized use in the summer and are managed as trails. During the winter, these roads are open to snowmobiling, as well as non-motorized uses (USFS 2003b). These roads are designated as local, maintenance level 1 roads. These existing NFSRs, I-70, U.S. 24, U.S. 6, and Eagle Bend county road would provide access to the proposed treatment units. Existing NFSRs 733.1, 748.1, and 749.1 would be used by logging traffic, including log hauling. **Table 3–74** describes the existing roads in MAs 5.4 and 5.43 near Minturn that would be affected, and the characteristics of each.

Table 3–74 Existing Forest Service Roads in MAs 5.4 and 5.43 Near Minturn

NFSR #	Length in Miles	Functional Type	Surface Type	Maintenance Level	Primary Maintenance Provider
733.1	2.7	L	NAT	1	USFS
748.1	5.5	L	NAT	1	USFS
748.1A	0.5	L	NAT	1	USFS
749.1	1.6	L	NAT	1	USFS
Total Length	10.3				

Notes:
1. Functional Type: L=Local; C=Collector; A=Arterial
2. Surface Type: AC=Asphalt; NAT=Native Material; AGG=Crushed Aggregate or Gravel
3. Maintenance Level: 1=Basic Custodial Care (Closed to public use); 2=High Clearance Vehicles; 3=Suitable for Passenger Cars; 4=Moderate Degree of User Comfort; 5=High Degree of User Comfort
4. Primary Maintenance Provider: S=State; C=County; CU=Commercial User; USFS=Forest Service; NK = not known

Line Shack Road, NFSR 748.1, is a native surface road that starts at Meadow Mountain parking lot, at the Holy Cross Ranger District administrative site. It extends 4.9 miles in relatively open meadows up to the line shack, and a faint two-track extends for an additional 0.6 miles to the end of the road. Drainage consists of ditches with relief culverts and water bars. Many of the drainage structures are not functioning properly and need to be reconstructed or replaced. Currently, spring runoff runs down the wheel tracks of the road in many places and has created numerous mud holes. The native surface is highly erosive (USFS 2003b).

Meadow Mountain Spur, NFSR 748.1A, may have been used for lift access and maintenance for a ski area that once existed on Meadow Mountain's slopes. A detailed road log was not conducted on this road. The road prism is still visible, however it is overgrown with vegetation and would require extensive reconstruction to allow for log truck traffic. No logging units are currently proposed that would require use of NFSR 748.1A for log transport (USFS 2003b).

Meadow Mountain Road, NFSR 749.1, starts at milepost (MP) 2.67 of NFSR 748.1. It is 1.6 miles long and extends to the edge of an existing clearcut area. The road continues as an unclassified road for an additional 1.2 miles to the edge of another clearcut area. The road is native surfaced and its drainage consists of ditches with relief culverts and water bars. The last section of road is not included in the Forest Service road inventory, and is not included in the 1.6 miles of NFSR 748.1. It was supposed to be closed after the last timber sale. A large part of the road is grown over with trees that are 3 feet tall, but the road is drivable to the last Grouse clearcut (USFS 2003b).

Hay Meadow Road, NFSR 733.1, is a native surface road that starts at the Grouse Creek Trailhead, which is approximately 1 mile south of the Holy Cross Ranger District administrative site and adjacent to U.S. 24. Hay Meadow Road is in an area that has numerous terrace ditches cut into the slopes. The road is 2.7 miles long, and 2.2 miles of this road were reconstructed for the Green Bear timber sale in 2000. Drainage consists of ditches with rolling dips. This road provides access to a drainage ditch, which is maintained by a permit holder. The road is in good condition and would require minimal reconstruction to allow for logging traffic (USFS 2003b).

Environmental Effects

Direct and Indirect Effects by Alternative

Alternative A – No Action

Under Alternative A, the No Action alternative, transportation management in the project area would remain nearly the same. There would be no change in the determining factors for changes to the road transportation system. There would be no changes to existing NFSRs and no addition of temporary roads. The density of open travelways would remain the same.

Alternative B

Under Alternative B, changes to the road system would apply to MAs 5.4 and 5.43 where lodgepole pine treatments would be accessed.

Road Density

The short-term addition of temporary roads to MAs 5.4 and 5.43 would increase the density of open motorized travelways during construction and treatment unit activities. An estimated 7.0 miles of temporary roads would be constructed in MA 5.4. The addition of 7.0 miles of temporary roads in MA 5.4 would increase the density of open motorized travelways in MA 5.4 to 1.7 miles per square mile, which would still be within the Forest Plan guideline. An estimated 4.0 miles of temporary roads would be constructed within MA 5.43 under Alternative B, which would include widening the Stone Creek trail for use as a temporary road. The resulting road density of 0.9 miles per square mile in MA 5.43 would not meet the density guideline for MA 5.43 during elk calving periods (May 15 to June 20). Closure of temporary roads in MA 5.43 during the elk calving season would meet the Forest Plan guideline for density of open motorized travelways.

Transportation Network

Over the short-term, access to lodgepole pine treatment areas would require use of existing roads, I-70, U.S. 24, U.S. 6, and Eagle Bend county road. The level of traffic generated by treatment activities would be limited to trucks hauling equipment and personnel to the treatment units and timber from the treatment units. Some heavy trucks and heavy equipment transport is anticipated. However, the highways and Eagle Bend county road are paved and have been constructed and maintained to accommodate heavy trucks and heavy equipment transport. Project personnel would also use the transportation network to access the project work site.

Visibility impacts along I-70 that could be generated from smoke during broadcast burns north of I-70 would be mitigated by measures contained in the Prescribed Fire Burn Plan. Mitigation measures include signage along I-70, wind direction prescriptions required prior to ignition, and smoke monitors on I-70 (Rebitzke 2004). These measures would ensure attainment of smoke management goals.

Traffic Flows and Volumes

Traffic flows and volumes would increase over the short-term during treatment activities. However, because individual project treatment activities would be short in duration, require few vehicle trips per day, and be spread out over time, increases in vehicles per day due to project treatment activities would not be noticeable relative to existing traffic. An estimated 750 truckloads would be required to remove approximately 3.75 million board feet of lodgepole pine from the lodgepole pine treatment areas. Approximately 1,500 vehicle trips would be required over a projected four-year contract period. When averaged over the four-year contract project period, approximately 375 additional vehicle trips per year or, on average, one vehicle trip per day (VTPD) would be added to the AADT. Should up to 70 percent of the basal area need to be removed from some treatment units to reduce fuels because of high MPB mortality, on average, one to two VTPD would be added to the AADT instead of one VTPD. The AADT on I-70 in 2003 was 21,741 and the AADT on U.S. Highway 24 was 6,853. Increases in AADT counts and percent trucks due to project traffic would not be noticeable. Increases in traffic levels occurring at any one time would be expected to fall within the current capacity of the roads.

During the most intense project activities, the VTPD could be 16 to 20. The AADT would not be affected because the AADT is an annual average. However, activities would be concentrated by treatment unit, and project-related traffic for any one treatment unit could be noticeable to a casual observer.

Additional wear and tear on roads is not anticipated because there would be few vehicle trips per day due to project activities. The NFSRs used for project activities would be closed to public for motorized use.

Potential for conflict would increase where project traffic turns off existing NFSRs 748.1 and 733.1 and onto U.S. 24. There would be a provision in the timber sale contract for safety signs. Signs would be posted at the junction of NFSRs with U.S. 24. Signs indicating cutting and loading activities would be placed on haul roads at the National Forest boundary (Currie 2004b).

Potential for conflict also would increase on Eagle Bend county road where project traffic would access a temporary road in the Stone Creek trail area and where public traffic enters Eagle Bend county road from driveways.

Existing Forest Service Roads

Existing NFSRs 748.1, 749.1, and 733.1 would be used during project treatment activities. Heavy trucks and heavy equipment proposed for treatment activities could have a disproportionate effect on road conditions relative to smaller and lighter passenger vehicles. Portions of these roads were reconstructed for previous timber sale activities. However, the remaining portion of these roads should be reconstructed for project treatment activities. Reconstruction activities may include regrading drainage ditches, cleaning blocked drainages, armoring drainages and dips, and installing culverts. Reconstruction of roads would involve 5.5 miles of NFSR 748.1, 1.6 miles of NFSR 749.1, and 2.7 miles of NFSR 733.1. Reconstructed roads would be maintained at their designated Forest Service maintenance level; Level 1 is defined as "basic custodial care (closed)." Maintenance at this level would accommodate heavy trucks and equipment. Over the long-term, NFSRs would be improved and environmental impacts would be decreased.

Potential short-term environmental impacts from road reconstruction would include sediment loss, erosion, or slope movement. Environmental impacts would be mitigated using appropriate sediment control barriers and BMPs. The types of impacts that could occur from improvements to existing roads are discussed in the Streams and Watershed, Soils and Geology, Vegetation, Recreation, and Wildlife sections of this chapter.

Temporary Roads

Temporary roads would be constructed to access lodgepole pine treatment units. The locations of these roads would be selected by the timber sale purchaser and would be subject to approval by the timber sale administrator. For the purpose of this analysis, it has been estimated that 11 miles of potential temporary roads would be constructed. Temporary roads would be low-standard, single-purpose roads that would be closed to the public.

There would be some increased soil disturbance and loss of wildlife habitat that would be roughly proportional to the increased miles of potential temporary access road construction. In general, temporary roads would be short, and placed where the topography and drainage requirements are minimal, reducing impacts.

Short-term potential environmental impacts from road reconstruction would also include sediment loss, erosion, or slope movement. However, environmental impacts would be mitigated by implementing design specifications during construction of temporary roads. These design specifications would reduce the potential for and occurrence of slope failure, excessive soil erosion, and degradation of stream channel conditions within and adjacent to the proposed treatment units. Temporary roads would not serve any long-term need and would be closed and obliterated after use. Temporary roads would not be designated as NFSRs and would not be recorded in the transportation inventory system.

Temporary roads would be maintained and appropriate sediment control barriers and BMPs would be employed over the life of the roads.

Alternative C

Under Alternative C, changes to the road system would apply to MAs 5.4 and 5.43 where lodgepole pine treatments would be accessed. The effects of Alternative C are the same as those for Alternative B, with the following exceptions.

Road Density

The widening of the Stone Creek trail for use as a temporary road would not occur under Alternative C. Instead, alternate access to Units 101 and 102 under Alternative C would reduce the temporary roads to 10.3 miles, however the temporary roads (7.0 miles) and the road density (1.7 miles per square mile) in MA 5.4 would be unchanged.

Alternate access to Units 101 and 102 under Alternative C would result in 3.6 miles of temporary roads, with a resulting road density of 0.8 miles per square mile in MA 5.43. The resulting road density would not meet the density guideline for MA 5.43 during elk calving periods (May 15 to June 20). Closure of temporary roads in MA 5.43 during the elk calving season would meet the Forest Plan guideline for density of open motorized travelways.

Transportation Network

The use of Eagle Bend Drive, a county road, would not occur under Alternative C. Project traffic would not access Eagle Bend Drive for project treatment activities.

Broadcast burns in Units 411 and 412 would not occur under Alternative C. Visibility impacts along I-70 would not be generated by smoke from these units. Pile burns are proposed for Units 301, 302, 303, 305,

306, 309, 310 and 313. Visibility impacts along I-70 that would be generated from smoke during pile burns would be mitigated by measures contained in the Prescribed Fire Burn Plan.

Traffic Flows and Volumes

There would be no potential conflicts between public traffic exiting driveways and project traffic using Eagle Bend Drive.

Alternative D

Under Alternative D, changes to the road system would apply to MAs 5.4 and 5.43 where lodgepole pine treatments would be accessed. The effects of Alternative D would be the same as those for Alternative B.

Broadcast burns in Units 412, 515 and 620 would not occur under Alternative D. There would be no visibility impacts generated by smoke from these treatment units along I-70.

Cumulative Effects by Alternative

Alternative A – No Action

There is evidence of human activity throughout the project area, including historic mining activities occurring around the beginning of the century. The disturbances caused by human activity in this area have a visual impact on the experiences of visitors. There have been 23 clearcut or partial cut sales in the project area between 1982 and 1992. Between 1999 and 2001, there were seven sanitation-salvage sales. These past harvest activities are listed in the Vegetation section of this chapter. Many of these sales added roads to areas. The old road platforms were not recontoured and evidence of these closed roads would be apparent to casual observers for many years. Other projects proposed for WRNF lands include a telecommunication site located on Vail Pass near Miller Creek

Under the No Action alternative existing NFSRs would not be reconstructed, which would not improve existing road-stream crossings. When added to other past, present, and reasonably foreseeable future actions, impacts to existing NFSRs would not be reduced.

Alternative B

Existing NFSRs would be reconstructed for project activities. When added to other past, present, and reasonably foreseeable future actions, existing NFSRs would be improved and impacts existing road-stream crossings would be reduced. Potential temporary roads would be obliterated after use and conditions would be restored to existing conditions once reclamation is completed. Therefore, when added to other past, present, and reasonably foreseeable future actions, temporary roads would not add impacts or increase road densities within the project area over the long-term.

Alternative C

The cumulative effects for Alternative C would not be expected to vary from those described above for Alternative B.

Alternative D

The cumulative effects for Alternative D would not be expected to vary from those described above for Alternative B.

Forest Plan Consistency

All alternatives are consistent with Forest Plan direction for transportation. Temporary roads would be low-standard, single-purpose roads that are closed after use. Reconstruction and maintenance of existing roads and public safety would be emphasized. Design of roads would minimize environmental impacts and travelways would not exceed density guidelines during periods designated for calving, migration, or other elk use. Seasonal restrictions for travelways would be implemented where appropriate.

Irreversible and Irretrievable Commitments

An irreversible or irretrievable commitment of resources would occur if resources are consumed, committed, or lost as a result of the project. The commitment of resources would be irreversible if the project started a process (chemical, biological, or physical) that could not be stopped. As a result, the resource or its productivity or its utility would be consumed, committed, or lost forever. Commitment of a resource would be considered irretrievable when the project would directly eliminate the resource, its productivity, or its utility for the life of the project and possibly beyond.

No irreversible or irretrievable effects on the transportation system would occur. Once treatments have been completed, the project area would provide a transportation system similar to the one that currently exists.

Actions such as road construction would, in most cases, be viewed as permanent actions on the landscape, although the effects would be lessened over time. Even though temporary roads would be obliterated at the conclusion of the project, the productivity of the reclaimed sites would generally not immediately equal the preconstruction condition. Over time, tree and understory species similar to the surrounding area will eventually regenerate the reclaimed areas. Unavoidable adverse effects associated with temporary roads, including soil erosion, sedimentation, slope movements, and wildlife impacts, are addressed in the Streams and Watershed, Soils and Geology, and Wildlife sections of this chapter.

3.4.5 Scenic Resources

Resource Description

The intrinsic beauty of the project area is a valued resource. Management activities could impact the quality of views from recreation use areas, residences, and travel routes that access a major portion of the project area. The existing landscape character reflects influences of natural processes and human activities. Changes in landscape character are managed by the Forest Service using scenery management system (SMS) objectives. Project activities have the potential to affect scenic quality, landscape character, and desired scenic condition in the project area.

Indicators

- Effects on existing scenic integrity (ESI), scenic attractiveness (SA), scenic class (SC), and visibility
- Whether or not scenic integrity objectives (SIOs) are met
- Intensity of mitigation needed to meet the SIO

Forest Plan Direction

The overall direction for managing the WRNF includes the national strategic goal to manage all NFS lands to attain the highest possible visual quality commensurate with other appropriate public uses, costs, and benefits (Forest Plan, page AA-17). Overall management direction for the WRNF also includes the regional goal of providing for scenic quality that responds to the needs of forest customers and local communities (Forest Plan, page 1-1). Forest-wide guidelines for scenery management (Forest Plan, page 2-34) apply to all areas of the Forest and include designing and implementing management activities to achieve, at a minimum, the level of scenic integrity shown on the SIO map. Vegetation manipulation will be planned, designed, and located so as to retain the color and texture of the landscape character, borrowing directional emphasis of form and line from actual features.

Desired Condition

The goal of SMS is to create and maintain landscapes having high scenic diversity, harmony, and unity for the benefit of society in general. Proposed project activities can affect landscape character, and the purpose of SMS is to manage those changes within an aesthetic and ecological framework. Scenic integrity indicates the degree of intactness, or wholeness, of the landscape character. The desired condition for scenery management is described below for each MA in the project area.

- 1.12 Primitive Wilderness – Scenery is managed to provide a range of SIOs from high to very high.
- 1.31 Backcountry Recreation, Non-Motorized – Scenery is managed to provide a range of SIOs from moderate to very high.
- 5.4 Forested Flora and Fauna Habitats – Scenery is managed to provide a range of SIOs from low to moderate.
- 5.41 Deer and Elk Winter Range - Scenery is managed to provide a range of SIOs from low to moderate.
- 5.43 Elk Habitat - Scenery is managed to provide a range of SIOs from low to moderate.
- 7.1 Intermix - Scenery is managed to provide a range of SIOs from low to moderate.
- 8.25 Ski Areas-Existing and Potential - Scenery is managed to provide a range of SIOs from very low to low.

Temporal Scope

The scenic resource may be impacted immediately (implementation to 2 years), in the short term (2 to 5 years), in the intermediate term (5 to 25 years), and in the long term (25 to more than 100 years). The duration of impact is highly dependent on the vegetation type.

Geographical Scope

The area that could be directly affected is the project area. The area that could be indirectly and cumulatively affected is the project area and any area outside the project area from which proposed management activities can be seen.

Affected Environment

Scenic resources on NFS lands in the project area are assessed within the framework of the SMS, which is used by the Forest Service to inventory and manage the scenic resources of a landscape. SIOs are associated with the degree to which a landscape is perceived to be intact, or whole, and are consistent with MA direction.

Forest Inventory of Landscape Elements

The SMS provides tools for the inventory and analysis of the aesthetic values, within the context of ecosystem management, on NFS lands. These tools include scenic attractiveness, landscape visibility, scenic class, and existing scenic integrity for the purpose of deriving SIOs.

Scenic Attractiveness measures the scenic importance of a landscape based on human perceptions of the intrinsic beauty of landform, water characteristics, vegetation pattern, and cultural land use. It is the primary indicator of the scenic beauty. Scenic Attractiveness is divided into three classes:

- **A (Distinctive)** are distinct areas with features of outstanding or unusual visual quality. Those features may be water forms, vegetative patterns, landforms, and rock formations.
- **B (Common or Typical)** are areas in the landscape that contain variety in form, line, color, and texture but are common throughout the character land type.
- **C (Indistinctive)** refers to areas in which the features have little change in color, form, line, and texture.

Landscape Visibility addresses the relative importance and sensitivity of what is seen and perceived in the landscape. Portions of landscapes, visible from travelways and use areas, are important to constituents for their scenic quality, aesthetic values, and landscape merits. Landscape Visibility consists of three elements: 1) Existing travelways and Use Areas, 2) Concern Levels, and 3) Distance Zones. The following list describes the elements.

- **Existing travelways and use areas** are identified and classified in order to determine which existing observer positions to use in the landscape visibility analysis. Travelways represent linear concentrations of public viewing (including highways, roads, railroads, trails, and waterways). Use areas are spots that receive concentrated public viewing use (including vista points, trailheads, campgrounds, and other recreation sites).
- **Concern Levels** are measures of the degree of public importance placed on landscapes that are viewed from travelways and use areas. Concern levels are divided into three levels (1, 2, and 3) based on the amount of use an area receives (high use, moderate use, or low use) and the amount of interest in scenery in a particular area (high, moderate, or low interest).
- **Distance Zones Plus Seldom Seen Areas** are determined by the observer distance: Immediate Foreground - 0 to 300 feet, Foreground - 300 feet to ½ mile, Middleground - ½ to 4 miles, Background - 4 miles to horizon, and Seldom Seen - from aircraft or occasional viewer.

Scenic Classes are not a separate inventory but an output from combining the Inherent Scenic Attractiveness inventory with the Distance Zones and Concern Levels. Mapped Scenic Classes are used during forest planning to compare the value of scenery with other resources, such as timber, wildlife, old growth, or minerals.

Scenic Integrity is a measure of the degree to which a landscape is visually perceived to be complete, indicating the degree of intactness and wholeness of the landscape character. Human alterations can sometimes raise or maintain integrity. Scenic Integrity is used to describe an existing situation, standard for management, or desired future condition. The highest scenic integrity ratings are given to those landscapes that have little or no deviation from the character valued by constituents for its aesthetic appeal. More often, it is lowered depending on the degree of deviation from the character valued for its aesthetic appeal. The frame of reference for measuring achievement of scenic integrity levels is the valued attributes of the "existing" landscape character "being viewed". Scenic Integrity is divided into two categories, inventoried (existing) and adopted (objective). Scenic Integrity Level (SIL) is based on the

existing landscape considering human alterations and landscape change (everything that has happened to a landscape.)

Existing Scenic Integrity or ESI indicates the degree of intactness, or wholeness, of the landscape character. The ESIs for the area are identified as very high, moderate, and low. A landscape without visual disruption, or with very minute disruption, is considered to have a very high ESI, and is perceived as unaltered. Moderate and low ESI levels are perceived as slightly to moderately altered. Landscapes that have increasingly discordant relationships among scenic attributes are said to have a low ESI.

The Scenic Integrity Objective or SIO is one of the components of the desired condition for scenic quality, and is described for each MA. SIOs are derived by considering the Scenic Classes, the existing Scenic Integrity Levels, and the integration of other resource objectives. The SIOs guide the amount, degree, intensity, and distribution of management activities that would achieve the landscape character goals. SIOs are defined by minimally acceptable levels and the direct intent to achieve the highest scenic integrity possible.

- **Very High** refers to landscapes where the valued landscape character is intact with only minute, if any, deviations. The existing landscape character and sense of place is expressed at the highest possible level.
- **High** refers to landscapes where the valued landscape character appears intact. Deviations may be present but must repeat the form, line, color, texture, and pattern common to the landscape character so completely and at such scale that they are not evident.
- **Moderate** refers to landscapes where the valued landscape character appears slightly altered. Noticeable deviations must remain visually subordinate to the landscape character being viewed.
- **Low** refers to landscapes where the valued landscape character appears moderately altered. Deviations begin to dominate the valued landscape character being viewed, but they borrow valued attributes such as size, shape, edge effect, and pattern of natural openings, vegetative type changes or architectural styles outside the landscape being viewed. They should not only appear as valued character outside the landscape being viewed but compatible or complimentary to the character within.
- **Very Low** refers to landscapes where the valued landscape character appears heavily altered. Deviations may strongly dominate the valued landscape character. They may not borrow from valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes or architectural styles within or outside the landscape being viewed. However, deviations must be shaped and blended with the natural terrain (landforms) so that elements such as unnatural edges, roads, landscape, and structures do not dominate the composition.

The project area is located within the Minturn, Edwards, Grouse Mountain, Red Cliff, Vail East, Vail West, Vail Pass, and Willow Lakes quadrangles and boasts views of pristine mountain peaks. It includes the southwestern portion of the Eagles Nest Wilderness and is adjacent to the Holy Cross Wilderness, areas with very high scenic values. Visibility conditions within the project area are generally very good. Landscape character descriptions for affected ecological subsections of the WRNF are contained in Appendix P of the Final EIS for the Forest Plan (pages P-6 to P-11 and P-28 to P-31). The project area lies within portions of two subsections, Gore-Mosquito Ranges (M331Ig) and Hard Scrabble (M331Hh). For portions of the subsections that are within the project area, the Gore-Mosquito Ranges subsection is within the Gore Creek watershed, and the Hard Scrabble subsection is in the Eagle Creek watershed. Subtype characteristics applicable to the project area have been tied into the following general landscape appearance description.

General Landscape Appearance

The region that encompasses the two subsections is characterized by steeply sloping mountains that are dissected by many narrow stream valleys with steep gradients. Upper mountain slopes and crests may be covered by snowfields and glaciers. High plateaus and steep walled canyons are common. The subsections in the project area are within the Subalpine Forest Belt dominated by subalpine-fir and Engelmann spruce, lodgepole pine, whortleberries and elk sedge to treeline. Above treeline, vegetation types include herbaceous dominated meadows, with turflands and snowfields. At lowest elevations, aspen and lodgepole pine forests are interspersed with mountain shrublands. Elevation of the subsection ranges from 8,500 to 12,500 feet. Precipitation ranges from 5 to more than 40 inches annually. Snowfall reaches 200 to more than 400 inches. Perennial streams are common, and small, isolated, high-elevation lakes are present. The region is characterized by high levels of scenic attractiveness, with many areas featuring distinctive (Class A) landscapes.

Project Area Landscape Appearance

The Gore Range to the east and the Sawatch Range to the south of the project area provide a stunning, rugged alpine backdrop to the river valleys and round to rugged slopes of the project area. As seen from a distance, the project area presents views that change markedly with the seasons. The upper slopes that characterize distant views of the project area present a uniform green and forested canopy during spring and summer months. The ski areas at Vail and Beaver Creek are visible as linear, straight-to-curved, green-to-straw colored clearings on the slopes south of I-70 that provide a textural and color contrast with the surrounding dark green forested canopy. During the fall season, the dense green canopy is interspersed with vivid gold colors of aspen stands. During winter months, aspen stands are visible as a brown to tan color that has moderate color contrast with the surrounding green conifer forest. When snow is present, ski runs present a strong color contrast of white clearings with the dark green conifer forest. Lodgepole pine that have died from MPB outbreaks appear throughout the forested canopy as straw-colored orange to red patches that provide a moderate to strong color contrast with the surrounding green canopy. Within a few years, the needles drop off, leaving a tan or gray standing snag that is not highly contrasting if it is among healthy trees.

When viewed in the middleground, the landscape exhibits a stippled appearance with light and dark contrasts between the greens of vegetation, and brown to tan soils and rock. Dead lodgepole pine are visible as stippled straw to red colors that also contrast with surrounding green vegetation. These color contrasts are strong in foreground to middleground views. Closer views reveal forest vegetation interspersed with grassy openings and rock outcrops that create a mosaic of texture, size, and color. Seasonal color contrasts are also strong in the immediate foreground to middleground views. A continuous cover of trees characterizes forested areas over much of the project area, with little diversity of openness in the stands, tree sizes and crown heights to provide a sense of structure. These characteristics contribute to the scenic quality of the area. The valley bottoms and lower mountainside south-facing slopes north of I-70 support aspen, grass and shrublands. In contrast, north-facing slopes on the south side of I-70 are characterized by dense stands of lodgepole pine. In general, as altitude is gained, a greater number of aspen stands are interspersed in dense coniferous forests.

The towns of Vail, Avon, Minturn, and residential and commercial developments along the I-70 corridor between the towns dominate middleground and closer views along the valley bottom. Vail is a world-class destination resort, and Minturn and Avon provide many services to the tourist population. The slopes within the project area provide a scenic backdrop to the towns, and provide recreational opportunities to residents and visitors.

The scenic attractiveness of the landscape in the project area ranges from areas that are typical (Class B) of the Gore/Mosquito Ranges and the Hard Scrabble subsections of the Southern Rocky Mountains to areas that are distinctive (Class A). Most of the project area consists of Class B landscapes. Class A landscapes include portions of some roadless areas, the Eagles Nest Wilderness, and lands adjacent to the Holy Cross Wilderness.

History of the Area

The Vail Valley area has a rich and varied history that is evident in the natural and human-made elements of the landscape. The vegetation in the project area is the product of settlement, grazing, wildland fire suppression, and timber harvests. Past vegetation practices such as timber harvest that shaped the project area are described in section 3.3.1 Biodiversity. Wildland fire effects and the conditions created by fire suppression are discussed in section 3.3.3 Fire and Fuels.

Equally influential to the distribution and composition of the current scenic qualities of the project area has been human presence. Native Americans, explorers, fur trappers, and miners all occupied the Vail Valley leaving behind evidence of their presence. Camps, cabins, trails, and wagon roads can be found throughout the area. Mining and timber roads, skid trails, mines and associated equipment, sawmills, irrigation ditches, stock trails, and railroads are visible parts of the landscape indicating the multiuse history of the project area.

There has been some adverse impact on the scenic quality of the vegetation component of the landscape from fire suppression and historical resource extraction activities. The even-aged forest dominated by lodgepole pine has lower variety of form, texture, and color than the historical forest. Some of the existing clearcuts do not follow natural vegetation patterns and are out of character with the existing vegetative mosaic of this area. Skid trails, landings, stumps, slash piles, root wads, and road systems developed for the harvests are evidence of past timber activities. The loss of aspen-dominated sites has also decreased vegetation diversity. The decline of aspen in Colorado is estimated at 49 percent (Bartos 2001). Aspen sites are typically high in biodiversity, as there is a greater variety of plant and bird species in aspen stands than occur in lodgepole pine. Scenic quality is enhanced by a variety in form, line, color, and texture of landforms and vegetation.

Current Condition

The project area is characterized by extensive stands of lodgepole (some stands mixed with Engelmann spruce), stands of aspen, and also by shrublands. In general, lodgepole pine comprises an estimated 90 percent of the standing trees in the project area. The remaining 10 percent is comprised of variable amounts of Engelmann spruce, subalpine fir, aspen and Douglas-fir. Except for the scattered geometric shapes of past clearcut activities totaling an estimated 790 acres and averaging less than 40 acres each, there are few to no breaks in the current single-story closed canopy condition. The mature lodgepole pine forests are arranged in a mix of small to very large, contiguous, single-story stands. The vegetation appears as very even-aged stands and represents extremely limited visual and structural diversity due to stand monoculture. The appearance of the past no longer exists in these stands. The forest within the project area lacks the visual diversity that would be characteristic of most natural landscape settings.

The Vail Valley is currently experiencing widespread MPB activity in stands of lodgepole pine. A tree that has been attacked remains an apparently healthy green color through the attack period and will remain green through most of the winter. Despite the green coloration, a successfully attacked tree is essentially dead. The telltale foliage coloration of a beetle-attacked tree will not appear until late the following spring when the green foliage turns a lemon yellow, which in turn becomes a straw colored orange and finally changes to the red of a dead tree. Lodgepole pine with the red coloration of dead trees are visible throughout the project area. After 3 to 4 years, all the brown needles fall off and the standing snag turns a tan or gray color and is less noticeable. Year-round recreational activities occur throughout

the project area and the associated impacts may be noticeable in the landscape (campsites, nordic ski huts, trailheads, non-motorized and motorized trails).

Landscape Visibility

Locations within the project area from where there would be public concern for quality of scenic landscapes include travelways, recreational use areas, and residential areas.

Recreation

The project area is currently being managed with recreational activities as the primary focus. The valley provides a world-class recreational setting, and is the setting for the Vail and Beaver Creek ski areas. Recreational activities are a primary use of the project area and drives the local economy.

The scenic attractiveness of the ski areas is Class B. The existing scenic integrity of the ski areas is very low because the natural appearance of mountain slopes have been highly altered with ski run clearings and other ski facilities. The level of concern for changes in the landscape would be low to moderate, because skiing activities occur in a highly modified setting and the level of concern is lower than the level of concern displayed by recreationists in areas that have a more natural appearance.

The public generally engages in viewing scenery along with other recreational activities. Several motorized and non-motorized trails and roads located throughout the project area provide a range of year-round trail-related activities, including the opportunity to view scenic landscapes. Trails are identified in the Recreation Resources Affected Environment section. The rugged terrain and forested vegetation limit most views of the project area visible from trails to views that range from the immediate foreground to middleground. Background views are generally limited to alpine peaks that soar above the foreground terrain and vegetation. However, some trails provide locations where scenic vistas of the project area and surrounding alpine backdrop can be seen. In general, the level of concern for the surrounding scenic landscape is high.

Travel Routes

The main road corridors through the project area carry large volumes of traffic to access destinations within and outside the project area. The I-70 corridor is the most traveled corridor through the project area. Traffic on I-70 ranges from 18,897 Annual Average Daily Traffic (AADT) in 2003 at the Vail East Interchange to 26,662 at the Avon Interchange. The change in AADTs at each end of the project area indicates that the project area is the destination for a large volume of traffic on the highway. U.S. 24 connects the town of Minturn with I-70. In 2000, the traffic volume was 6,903 AADT at Minturn Road (CDOT 2004b).

The AADT counts for I-70 and U.S. 24 indicate that there are a large number of travelers who view the project area. Views of the project area are limited to foreground to middleground views at most locations along the highway because of the winding valley and rugged terrain. However, as the terrain unfolds before the traveling vehicle, most of project area becomes visible to motorists as they travel through the valley. In addition, portions of the project area are visible to viewers on I-70 and U.S. 24 as they approach the I-70 corridor from the south. Because there is a large number of viewers on the highways, the overall level of concern is high. Most project area landscapes viewed from I-70 are Class B landscapes with scenic integrity levels ranging from very low to very high, with the majority of the area classified as moderate. The Eagles Nest Wilderness adjacent to the highway on the west side of the project area, is a Class A landscape with a very high scenic integrity level.

There are local county roads, residential access roads, and NFSR roads in or within viewing distance of the project area. Users of these roads are likely to be local residents and recreationists with a higher level of concern for scenic landscapes. The viewshed of most of these roads contains Class B landscapes with a moderate level of scenic integrity.

Residential

The towns of Vail, Minturn, and Avon have a total permanent population of about 12,000 residents in 2002, and a large transient population during the ski season. In addition, there are residents living outside municipal boundaries in unincorporated Eagle County. Slightly more than 40 percent of the housing stock in the three communities is seasonal homes, indicating that the transient population is present in the valley for a substantial portion of the year. Many of these residents live and work in the valley to enjoy the recreation opportunities and scenic landscapes of the region. In general, the permanent and transient populations have a high level of concern for the scenic quality of the surrounding landscape. NFS lands that are visible from residential areas are Class B landscapes with primarily very low (ski areas) to moderate scenic integrity levels.

Scenic Integrity Objectives

The SIOs are derived from inventories and the integration of other resource objectives. They describe how a scenic resource will be managed. Management activities are to be compatible with the SIO classifications. NFS lands in the project area are managed with five SIOs ranging from very low to very high, as shown on **Figure 3–7**. Most of the NFS lands in the project area are perceived as slightly altered, and have been classified with a moderate SIO. Moderate SIO areas include most lands within inventoried roadless areas and NFS land that has not been developed with ski facilities. The Vail and Beaver Creek ski resort facilities are classified as low SIO because the landscape appears moderately altered. The Eagles Nest Wilderness within the project area has an unaltered natural landscape character, and an SIO of very high. Lands that have a high SIO appear unaltered and are located inside designated wildernesses and some inventoried roadless areas.

Environmental Effects

Direct and Indirect Effects by Alternative

The purpose of the proposed lodgepole pine treatment activities is to promote a diversity of age classes and reduce tree densities to increase the ability of lodgepole pine stands to resist current and future MPB outbreaks. The treatment stands consist of mature lodgepole pine stands that have become increasingly susceptible to large-scale disturbances such as wildland fire, disease, and insect infestation. These processes, if not treated, often introduce visual elements into the landscape from tree mortality. The yellow to rust colors of trees that have died from MPB or fire damage change to gray over time.

Visual effects generated by proposed management activities, including thinning, patch cuts, sanitation, and salvage in lodgepole pine, aspen enhancement, and fuels reduction in shrublands and aspen communities, vary in duration and intensity. Users of the trails and roads that would remain open within the project area would experience most of the visual impact from the project.

Figure 3–7 Scenic Integrity Objectives

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Alternative A - No Action

Under Alternative A, the No Action alternative, activities such as non-commercial vegetation treatments, prescribed fire projects, and associated management activities would not take place at this time. Vegetative succession by natural processes would continue in the project area. Existing management activities and recreational use of the area would continue and the project area would be managed to protect and maintain existing improvements and uses. The No Action alternative likely would lead to a buildup of fuels and potential for increased severity or extent of wildland fire, which potentially would have a greater effect on scenic resources.

Existing scenic integrity of the landscape would continue throughout the project area over the short-term. The timber stands, including the mature lodgepole pine stands, initially would remain in their current condition with minimal vegetative diversity. The existing vegetation would not be treated. As each year passes, more stands would be susceptible to natural wildland fires and additional MPB infestation. As the trees become older, they would gradually die and fall to the ground. The condition of untreated aspen stands would decline over time. More than 1,900 acres with a significant aspen component would not be treated under the No Action alternative. Lodgepole pine and other conifers would replace aspen communities, reducing the visual diversity of the landscape and its scenic integrity. Human influences over the project area would increase over time, as developed areas and recreation activities expand. Over the long term, the scenic character would change by natural processes such as fires, MPB infestation, or decline of aspen communities, and human impacts from expanding development and recreation activities. This could contribute to a long-term decline in scenic integrity.

Natural processes would keep the forest in a mature appearance and the interaction between the natural processes and human influences would continue. Fires may occur due to human-caused or natural ignitions. Lodgepole pine stands are characterized by a fire regime consisting of high intensity surface fires that kill most of the surface vegetation within the path of the fire. A continued increase in dead and down material on the forest floor, and an unhealthy timber stand, would contribute to a decline of scenic quality in the area. The existing scenic integrity would decline over the long term under the No Action alternative. SIOs may not be met over the long-term. No mitigation to meet the SIOs would apply under the No Action alternative.

Wildland fire would greatly affect the scenic integrity of any landscape. Wildland fire and the suppression of wildland fire often leave significant scars that remain visible in the landscape for several years.

Alternative B

Under Alternative B, vegetation management activities and associated road construction may impact scenic resources by altering existing line, form, color, and texture in the affected viewsheds. Treatment of timber stands and construction of associated roads have been designed to conform to existing landscape features. The SIOs assigned to a MA by the Forest are used in locating and designing timber treatment stands.

The ongoing increase in lodgepole pine killed by MPB is a negative element in the landscape, and increases the potential for wildland fires. Uniform overstory composition and structure and declining understory diversity also lessen visual diversity in the landscape. These conditions have resulted in a decline of the visual quality of the project area.

Treatments in a given unit would consist of a combination of thinning from below, patch cuts, sanitation, salvage, mechanical fuel treatments, cutting by chainsaw, and piling and burning, depending on the stand treated and the treatment(s) that would best accomplish the project objectives. Individual treatment units would range in size from 5 to 132 acres (**Appendix D**). Treatments would be accomplished using chainsaws, rubber tire skidders, or other equipment to be used at the contractor's discretion.

Fuel treatments accomplished using chainsaws or mechanical equipment would result in the accumulation of debris piles scattered throughout the treatment units. The visual impact of debris piles would be temporary, as the materials would be disposed of in several ways, as described in **Appendix D**. Once the debris is disposed of, fuel treatment areas would appear natural to the casual observer. In some areas, treatment would enhance the visual quality by opening up views into the stands. Treatment units that have been thinned to remove trees infested by MPB, and dead and down material would be characterized by a somewhat more open appearance than before management activities were implemented.

The vegetation management techniques would renew timber stands without jeopardizing other uses of the area. The proposed activities would minimize or reverse the declining conditions of the existing stands, and in the long term, enhance the scenic attractiveness of the landscape. The removal of a portion of the dead and down material also would reduce the wildland fire hazards.

Mitigation of impacts to scenic resources is described in Chapter 2 and does not vary among the action alternatives. The intensity of mitigation needed to meet the SIOs also would not vary among the alternatives. The omission of some treatment units under some alternatives could affect whether SIOs would be met in the long-term in all areas. However, the intensity of mitigation would not affect whether SIOs can be met where treatment units are dropped.

Visual Impacts

Treatment activities can affect scenic resources because of contrasts created between natural forest landscapes and those modified by management activities. These contrasts consist of changes in line, form, color, and texture of the vegetation and landform. The effects that alterations have on these features are dependent on individual human values. The ability to control how disturbances appear depends upon the treatment used, landform, soil type, silvicultural prescription employed, slash disposal, cleanup, design of the treatment unit, the implementation, and the fire control method. Access roads would impact the existing scenic integrity in areas of high visibility for foreground to background views. Visual impacts would be greater where evidence of treatment activities (slash, stumps, landings, skid trails, roads, or paint) and prescribed fire activities (fire lines, tree-crown scorch, blackened tree trunks, killed understory vegetation and a blackened forest floor) are evident in foreground views.

In general, the longest lasting visual impact comes from soil disturbance or color contrast generated from tree removal or fire operations. Edges of the units would be designed to have a natural appearance by avoiding straight edges and unnatural appearing shapes. The type of treatment method or intensity of fire used for the vegetation treatment may also contribute to the visual impact. Opportunities to minimize visual impacts are greater where slopes are less steep and unit size and shape can be manipulated more effectively.

The following table shows the level of effects for each treatment method. Treatment methods include tree removal, pruning, chipping, and prescribed burning.

Table 3–75 Potential Effects on Forest Scenery by Treatment Method

Treatment	Form	Line	Color	Texture
Selective Thinning	Removing trees would increase the structural diversity. The units are designed to blend into the patterns of the natural vegetative mosaic.	Thinning the trees would decrease the number of trees, which would emphasize the strong vertical line of the existing stand. Trees would be selected in a process that would not create unnatural lines in the canopy from treatment activity.	Color of healthy vegetation in stand would remain unchanged. Orange to rust colors of MPB-killed lodgepole pine would be removed. Some additional undergrowth would add a little variety. Seasonal color would be enhanced by treating lodgepole pine, enhancing aspen stands, and breaking up the canopy.	Species diversity and the resulting uneven-age distribution of the stand would create a more complex texture of the canopy.
Patch Cuts	Small openings would create diversity in canopy closure. Units are designed to blend with the natural vegetative mosaic.	Feathering would scallop edges of patches cut to mimic natural patterns in the landscape.	Variety of color would be enhanced with ground cover in small openings .	Species diversity would create a more complex texture within the treatment units.
Broadcast Burning	Sagebrush would be removed by burn, resulting in less diversity of form.	Feathering edges of burn areas would mimic natural patterns.	Colors of grasses and forbs would create attractive contrast with surrounding shrubby landscape by the following growing season.	The recovered burn area would enhance textural contrasts between shrub growth and grassy clearings.
Mechanical Treatments	Hand or machine piling evidence from cut and leave, prune, chip treatments would contrast with surroundings over short-term. Over the long term, removing trees by would increase the structural diversity.	Short-term contrasts of jagged lines of mechanical treatment debris. Over the long term, thinning the trees would decrease the number of trees, which would emphasize the strong vertical line of the existing stand.	Low color contrasts from treatment debris. Over the long term, gray colors of MPB-killed lodgepole pine would be removed. Some additional undergrowth would add a little variety. Seasonal color would be enhanced.	Species diversity would create a more complex texture within the treatment units.

Treatment	Form	Line	Color	Texture
Pile Burning	Pile burning of mechanical treatment debris piles would remove the geometric forms of piles that contrast with the dominant vertical lines of the surrounding forest, restoring a natural diversity of form.	Noticeable short-term edge between burned areas and surrounding vegetation would be lessened by feathering edges to mimic natural patterns.	Colors of grasses and forbs would create attractive contrast with surrounding forested landscape by the following growing season.	The recovered burn area would enhance textural contrasts between lodgepole pine stands and grassy clearings.

Forest Treatments

Lodgepole pine would be thinned. This treatment would create more structurally diverse stands. Lodgepole pine stands would be thinned to leave approximately 50 to 70 percent of the basal area within the harvest units. This equates to leaving from 150 to 300 trees per acre with a variable spacing of 15 to 30 feet between trees. The treatment method has a low visual impact, as the thinned stands would have a natural appearance once treatment activities have been completed. Stands or portions of stands that would be treated with sanitation and salvage would have a higher visual impact than the 50 to 70 percent removal treatment. More of the larger, dominant trees would be cut, creating a more noticeable change to stand structure. However, because sanitation and salvage would be used in areas with high MPB damage and mortality, removal of the dominant trees by MPB is highly likely even without treatment. Removing infested and dead trees would reduce their visual effect on the landscape both from distant and close vantages. In the short term, thinning of trees would enable better growth and vigor for the younger individuals. In the long term, the stands would produce healthier trees with a better overall stand appearance. Based on the view potential of the units, all the units have been designed to minimize their visual impact. Various tools would be used during project design, such as controlling the locations of openings, designing unit shapes to mimic the adjacent vegetative mosaic, and implementing visual resource design criteria. Initially, tree paint marked on trees adjacent to the roads and trails, stumps, slash, root wads and skid trails would be noticeable to users. Additional visual design criteria would be used to reduce the visual impact of the proposed activities. The recommended actions are described in **Appendix D**.

Aspen would be patch-cut within 200 feet of the National Forest boundary and the boundaries of affected inventoried roadless areas. Patch-cut clearings would be 2 to 10 acres in size. The openings would be irregularly shaped with feathered edges. The thinning on the edges of existing cuts would soften the hard edges and make the openings blend in better with more of a transition. Where possible, the new patch cuts would be laid out in shape with feathered edges to appear more like natural openings. The thinning along the private property boundaries of the urban interface zone would have a softening effect. A linear appearance would be avoided because of the variable spacing of residual trees and the uneven width of the thinning. In the short term, the stands would have a positive effect on the vegetative mosaic and some existing cuts would have a more natural appearing edge. In the long term, the vegetative mosaic would be varied with different sizes of natural-appearing openings and diversity in stand character, species and age class. The texture, color, and canopy of the stands would have variety and diversity. Evidence of treatment activities would be apparent to users of the trails in the immediate foreground views along the trails (most impacts would occur within 100 to 200 feet of either side of trails). Evidence of the treatment activities would be noticeable to users of the roads that remain open.

Prescribed Fire

Fire management activities such as the disposal of debris and the use of prescribed fire can also diminish scenic quality. Because these activities would be implemented with an understanding of the natural role and historical effects of fire on landscape character, and with the implementation of the visual resource mitigation techniques described in Chapter 2 and **Appendix D**, management activities can be visually pleasing. In some situations, however, fire can have considerable negative visual impacts, particularly on vegetation and on the forest floor in the foreground views. Such negative effects often include tree-crown scorch, blackened tree trunks, killed understory vegetation, and a blackened forest floor. The public may consider such effects unattractive. Past forest fire prevention programs have given fire a bad public image, but this image is gradually changing. Using fire as a management tool requires the public to accept the perspective that fire has an overall positive effect on landscape character in the long term. This has already occurred in some areas and the public is becoming more accepting of short-term visual impacts for the long-term positive gain.

Road and Trail Activities

Road reconstruction activities would be visible along the roads associated with treatment and hauling activities. Timber treatments and associated activities would be visible from the air, but the visual impact would be minimal. Evidence of the open roads and road segments designated for closure would be apparent for several years. The road closure methods for temporary roads would minimize the amount of visual disturbance from the sight distance, as viewed from the point of closure and/or the first one-quarter mile. The long-term visual impacts would be diminished using this method of closure. For the remainder of the roads, which are beyond the view from the point of closure, evidence of the road platform would remain. Evidence of the landings also would be apparent, but the duration of time would depend on the amount of grading and disturbance required to construct them. Initially, the disturbed areas would be revegetated with a native seed mix. The new vegetative cover and the slash and debris covering the road platform would soften the edges of the disturbance. Eventually there would be trees growing in the old road platform. The visual impact of the road closures and landings would diminish over time as the roadbeds revegetate after they are closed. In summary, all of the treated acres would meet the Moderate SIO with the recommended design criteria described in **Appendix D**.

Landscape Visibility

Treatment units would be visible from travelways, recreational use areas, and residential areas in the project area. Treatment units that are not visible or are not obvious from these viewpoints are Units 301, 302, and 303. The treatment units are generally located in or near the wildland urban interface.

Travel Routes

The Concern Level 1 standards are intended for travel routes of primary importance, high use volume, and long use duration. The Concern Level 2 standard is intended for travel routes of secondary importance (local importance), low volume, and short use duration. The I-70 and U.S. 24 corridors are Concern Level 1 travel routes. All the other roads within the project area are considered Concern Level 2. However, the entire project area has a high Scenic Class, which takes into account factors such as concern levels, visibility, and scenic attractiveness. When all these factors are considered, the High Scenic Class designation is more influential than the Concern Level 2 designation for the project area. Mitigation would ensure that any changes made in the landscape remain visually subordinate to the natural landscape character.

Treatment units that would be visible in foreground views of I-70 are Units 411, 412, 514, and 515, which are on NF administered lands managed with a High SIO. Unit 619 within the Spraddle Creek inventoried roadless area also would be visible to motorists. Units 128 and 129 would be visible briefly to motorists traveling south on U.S. 24. These units would be located on the west-facing slope of a drainage, and would be screened from most views along the highway. Other units would not be visible in foreground views to motorists traveling on the highways because they would be screened by the terrain and intervening vegetation.

There would also be some middleground and background views of the treatment units and associated activities within the project area, as viewed from I-70, U.S. 24, several county roads, private roads and recreation areas such as Vail ski resort. A larger number of units would be visible in middleground and background views, however they would be subordinate to the characteristic landscape at distances greater than one-half mile. The visible units would have a natural appearance in the landscape at these distances once treatment is completed and new growth has obscured burned areas.

Recreation

The Forest Development Trails (FDTs) that lie in the vicinity of the proposed project are listed below. These trails receive high to moderate use year around, with a high public value placed on these trails. Because these trails are of primary importance, have a high use volume, and most users would be using these trails for a longer duration, all segments of these trails are inventoried as Concern Level 1 trails. The entire lengths of the trail corridors for all trails listed below should be managed to a Concern Level 1 standard. Although these corridors may not currently meet these standards, the management of these trails through this project and future management can bring them up to this standard in the future. The design criteria described in **Appendix D** would help the project meet the SIOs.

The treatment units are generally visible from the trails in the immediate foreground and foreground distance zones. Unless otherwise stated, treatment units in middleground zones are obscured by the rugged terrain and vegetation that occur in the foreground view of the trails.

FDT 1851 (Bowman's Shortcut) is outside project area. The trail overlooks a portion of the southeast part of the project area. No treatment units are visible from this trail.

FDT 1880 (Spraddle Creek) is in MA 5.4. Unit 619 is in foreground views of the south end of the trail. The trail is managed with a Moderate SIO.

FDT 1896 (North Vail Trail) is in MAs 1.31, 8.32, and 5.4. Units 617, 618, and 619 are in foreground views of the trail. The trail is managed with a Moderate to High SIO within the project area.

FDT 2005 (Two Elk) is partly within MA 5.5 where it crosses through the project area. No treatment units are visible from this trail. The trail is managed with a Moderate SIO within the project area.

FDT 2006 (Cross Creek) is outside the project area along a drainage. No treatment units are visible from this trail.

FDT 2011 (Booth Lake) trailhead is in MA 5.42 in the project area. Most of the trail is located north of the project area. No treatment units are visible from this trail. The trailhead area is managed with a High SIO.

FDT 2012 (Pitkin Creek) is partially within the project area in MA 1.12. Units 411 and 514 are within foreground views along the south end of this trail. The trail is managed with a Very High SIO.

FDT 2013 (Bighorn Creek) is in MA 1.12. Portions of treatment Units 411, 514, and 515 are in foreground views in the south part of this trail. The trail is managed with a very High SIO.

FDT 2014 (Deluge Creek) is in MA 1.12. Units 412 and 515 are in foreground views of this trail. The trail is managed with High and Very High SIOs.

FDT 2015 (Gore Creek) is in MA 1.12. Units 412 and 515 are in foreground views of this trail. The trail is managed with High and Very High SIOs.

FDT 2106 (Buck Creek) is on private lands and on NFS lands in MAs 5.41 and 5.4. Units 305, 306, and 310 are in foreground views of this trail. The trail is managed with a Moderate SIO.

FDT 2107 (Nottingham Ridge) is in MA 5.4. Unit 309 is in the foreground view of a portion of this trail. The trail is managed with a Moderate SIO.

FDT 2110 (Buffer Mountain) is in MA 1.31. The upper part of the trail is on a ridge, so that portions of Unit 620 may be in middleground view of this trail. The trail is managed with High to Very High SIOs.

FDT 2111 (Buffer Creek) is in MAs 1.31 and 5.4. No treatment units are visible from this trail, as it is located in a drainage such that all treatment units are screened by the terrain. The trail is managed with a High SIO.

FDT 2127 (Grouse Lake) is in MA 5.4. Units 118, 120, 121, 122, and 123 are visible in the foreground view from this trail. The trail is managed with a Moderate SIO.

FDT 2128 (Martin Creek) is in MAs 5.4 and 5.42. Units 127, 128, and 129 are in the foreground views of this trail. The trail is managed with a Moderate SIO.

FDT 2129 (West Grouse Creek) is in MA 5.4. Units 116, 117, 118, and 119 are in foreground views of this trail. The trail is managed with a Moderate SIO.

FDT 2130 (Game Creek) is in MAs 5.41 and 8.25. Unit 313 is in the foreground view of nearly 1.5 miles of this trail. The trail is managed with a Low to Moderate SIOs.

FDT 2136 (Son of Middle Creek) is in MA 5.4. Units 617, 618, and 619 are in foreground views of this trail. The trail is managed with a Moderate SIO.

FDT 2348 (Whiskey Creek) is in MA 5.43. Units 103, 104, 105, and 106 are in foreground views of this trail. The trail is managed with a Moderate SIO.

FDT 2349 (Paulie's Plunge/Stone Creek) is in MA 5.43. Units 101, 102, and 103 are in foreground views of this trail. The trail is managed with a Moderate SIO.

FDT 2350 (Paulie's Sister) is in MAs 5.43 Units 101 and 102 are in foreground views of this trail. The trail is managed with a Moderate SIO.

Evidence of the treatment activities would be apparent to users of the trails in the immediate foreground views along the trails (most impacts would occur within 100 to 200 feet of either side of trails).

Residential

Because of the size of the project area and its proximity to an urban setting, project activities would be visible from many different viewpoints throughout the area. The towns of Vail, Minturn, and Avon, and

associated private residences are all within the viewshed. There are also many recreation sites around Beaver Creek and Vail ski areas. Most of the treatment units would be screened from views of residences in these areas by the rugged terrain and intervening forest vegetation. Those residences that back up to the National Forest would be able to view treatment activities, and the debris remaining from treatment; however, once treatment activities have been completed, the visual appearance of the stands would be improved.

Based on the view potential of the units as seen from travelways, recreation areas, and communities, all the units have been designed to minimize the visual impact. Various tools described in **Appendix D** as design criteria would be used during project design, such as controlling the locations of openings, designing unit shapes to mimic the surrounding vegetative mosaic. Initially, paint marked on trees adjacent to the roads and trails, stumps, slash, root wads and skid trails would be noticeable to users. Additional visual design criteria would be used to reduce the visual impact of the proposed activities. The recommended measures are described in **Appendix D**.

Forest Vegetation Simulator

The Forest Vegetation Simulator (FVS) system includes a graphical user interface that produced a visual simulation of the model results for proposed treatments in lodgepole pine. The simulations in depict the appearance of a typical stand for lodgepole pine before treatment activities and the projected appearance of the stands 10 years after two potential treatments. The simulations for lodgepole pine stands show the appearance for two target basal areas of 75 sq. ft. per acre and 125 sq. ft. per acre. Also shown are the same stands following removal of 70 percent of the basal area from above, representing sanitation and salvage of heavily infested stands. Basal area is a measurement of stand density, and is the sum of the cross-sectional areas in square feet of the individual trees measured 4 ½ feet from the ground. For all lodgepole pine treatment units, each target basal area would require the removal of 30 to 50 percent of the existing lodgepole pine, depending on the initial basal area of each unit. Two treatment units were selected to represent the appearance of stands before and after treatments, including sanitation and salvage. The simulated treatment units are Units 102 and 118. Unit 102 was selected to simulate a unit with a high percentage of basal area removal. The Stone Creek Trail crosses the bottom of Unit 102. The Paulie's Plunge Trail looks across Stone Creek to Units 101 and 102. The unit is also visible in background views from east-bound I-70 located northeast of the unit. The existing basal area for Unit 102 in 2004 was 133 sq. ft. per acre. The proposed treatment involves the thinning of the unit to remove 44 percent of the lodgepole pine to a target basal area of 75 sq. ft. per acre. **Figure 3–8** shows a simulation of the existing basal area of the Unit 102 in 2004 and the basal area of the unit in 2014, after 10 years of new growth. **Figure 3–8** displays the stand structure in 2004 and the future basal area in 2014 for Unit 118. This unit has an existing basal area of 180 sq. ft. per acre, and would be thinned by 31 percent to achieve a target basal area of 125 sq. ft. per acre. Unit 118 is located in the immediate foreground views of the West Grouse Creek trail. The simulations of the two treatment units illustrate the appearance of a range of basal area removal for thinning, as well as a range of target basal areas.

Under Alternative B, broadcast burning would be used to treat shrublands in fuels treatment units (**Appendix D**). There would be short-term visual impact for no more than 1 week following a burn from the smoke generated by the fire. Most visibility impacts from smoke would occur on the day of the burn. It can be expected that several burn days would be required to complete all the prescribed burns, which likely would be accomplished over 4 to 5 seasons, but which could be accomplished over 2 seasons if the maximum feasible acres were burned each year. Broadcast burning in the spring would blacken the burned area for about 4 to 6 weeks, creating a short-term visual impact. A fall burn would blacken the burned area for up to 8 months, but the burned area would be under snow cover for much of this time. Temporary closures or signs that notify the public of broadcast burns could be needed for 1 to 2 days.

Figure 3–8 Visual Simulation of Proposed Treatments in Lodgepole Pine

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There would be a nutrient flush generated from the fire and new ground cover consisting of grasses and forbs would appear with a bright green color the first season following the broadcast burns. The fire would appear as a naturally occurring fire with the design criteria implemented. It would meet the SIO of High to Very High, but there would be a noticeable change in the existing character of the vegetation. In the long-term, the burned areas would continue to have only minimal sagebrush cover, but burned areas would blend with surrounding untreated areas. The character of the landscape would not have a drastically different appearance than the surrounding area. The evidence of the fire would be noticeable until the following growing season.

This alternative would have a positive overall visual effect due to the improvement in the vegetation health and the long-term visual improvement of the vegetation. The visual impacts would be caused by the prescribed fire and forest thinning activities. Impacts would be related to number and size of units treated, comparison of unit size to size of the existing natural openings in the area, location and number of landings, miles of roads reconstructed, obliterated, and scarified. For the Stone Creek temporary road, which would be converted back to a trail once treatment activities have been completed, a portion of the road platform would be ripped. There would still be evidence of the road platform, but it would not be as noticeable once vegetation is growing. The activities associated with the treatment and prescribed fire activity would also be visible from the air, but the visual impact would not exceed the SIOs. SIOs would be met under Alternative B over the short- and long-term.

Alternative C

Alternative C differs from Alternative B in that fuels treatment units outside the Eagles Nest Wilderness would be treated with mechanical fuel reduction and pile burning rather than broadcast burns. Pile burning would involve hand piling, and machine piling if authorized for a specific treatment unit. Piles could be present for 1 to 2 years before they are burned, creating a noticeable visual impact of short-term duration. Hand piles each could contain 400 cubic feet of cut vegetation, which would cover an area that is 10 feet by 10 feet to a depth of 4 feet. Machine piles, where used, likely would be 3 to 5 times larger than hand piles. There could be an estimated 8 to 10 hand piles or 2 to 3 machine piles per acre treated. Piles could be located within 20 feet of trails. Pile burning in the spring would blacken the burned area for about 4 to 6 weeks, creating a short-term visual impact. A fall burn would blacken the burned area for up to 8 months, but the burned area would be under snow cover for much of this time.

The visual effect of smoke would be less under this alternative. Fuels treatment units within the Eagles Nest Wilderness would be dropped, which would contribute to declining forest health and scenic attractiveness. SIOs may not be met over the long-term in the Corral Creek inventoried roadless area or Eagles Nest Wilderness. These units are in the foreground of views from Pitkin Creek, Bighorn Creek, Buck Creek, Swift Gulch, and Nottingham Gulch trails. The Stone Creek trail would not be widened for treatment access under this alternative to avoid conflict with recreation uses; however, there would be slightly more visual effect from an additional disturbance under Alternative C associated with temporary roads, landings, cable corridors, and tractor trails for lodgepole pine treatment units. All of the acres treated would meet the SIOs with the recommended design criteria implemented.

Mechanical fuel reduction and pile burning would create piles cut of vegetation that contrast with the surrounding landscape until burned. There would be short-term visual impacts of no more than a week from the smoke generated by pile burning, the majority of impacts would occur on the day of the burn. Several burn days would be required to dispose of all piles. The evidence of the pile burns would be noticeable until the following growing season. The character of the landscape would have a similar appearance to the surrounding area as viewed from middleground to background distance zones.
Mechanical treatments would occur in areas managed primarily with a Moderate SIO. Fuels treatment units near the Eagles Nest Wilderness are managed with High to Very SIOs. Once treatment activities are

completed, the primary deviation from the existing scenic integrity would result from mechanical treatments and patch cuts, including debris such as slash, stumps, and root wads. The evidence of mechanical treatments would be most obvious in immediate foreground views within 100 to 200 feet of roads and trails. These deviations from the existing conditions would be obvious to viewers, but would be subordinate to the overall landscape character, which would meet the Moderate SIO over the short-term and long-term. The SIOs of High to Very High likely would not be met in the foreground zones of trails along Gore and Deluge Creeks, as the visual evidence of treatments would be obvious to users of the trails. However, despite the obvious change to the naturalness of the landscape, the overall scenic attractiveness of the landscape as seen from these trails would be enhanced over the long-term, as the improved ecosystem health would contribute to the scenic attractiveness of the landscape. The implementation of Alternative C would result in a greater degree of deviation from the existing scenic integrity of project area landscapes than Alternatives B or D.

Alternative D

Alternative D was developed to reduce impacts associated with the cutting of trees on roadless area characteristics. Inventoried roadless areas should appear to have been affected primarily by the forces of nature, with the imprint of human activity substantially unnoticeable. Alternative D differs from Alternative B in that no cutting of trees would occur in inventoried roadless areas beyond a 200-foot buffer along the boundary between NF administered lands and private lands in the Vail Intermountain area.

There would be no treatment in Units 201, and 203 through 209 under Alternative D. Unit 202 is the interface between the National Forest and private lands, and would be treated under this alternative. These units are dominated by aspen, and are located in an area within the Game Creek inventoried roadless area that is managed with a Moderate SIO. Elimination of these aspen enhancement units would allow successional pressure from encroaching pines to continue to hinder aspen recruitment and impact aspen vigor. In the absence of disturbance, lodgepole pine and other conifers would eventually replace aspen in this area, reducing the visual diversity of the landscape, including the existing scenic integrity of the Game Creek inventoried roadless area.

Unit 620, a fuel treatment unit in the Buffer Mountain inventoried roadless area, would not be treated under this alternative and the acres treated within Units 618 and 619 would be greatly reduced. The existing scenic integrity of this inventoried roadless area could decline within the proposed treatment units with the reduced diversity and fuels buildup in these stands. SIOs would be met under Alternative D in the short-term, however, SIOs in the Game Creek and Buffer Mountain inventoried roadless areas may not be met in the long-term due to omission of treatment units that would improve forest health in these areas.

Alternative D would involve the smallest number of acres treated in inventoried roadless areas. Treatment units in inventoried roadless areas would be either reduced in size or dropped. Implementation of the alternative would result in the fewest effects to roadless area characteristics compared with the other action alternatives. However, the condition of untreated aspen stands in inventoried roadless areas may deteriorate over the long term, as pine trees encroach into aspen stands and replace aspen stands, thus reducing the overall diversity of vegetation. The existing landscape appearance would also deteriorate, and would deviate to an increasing degree over time from the existing scenic integrity levels. Most affected inventoried roadless areas are managed to meet a Moderate SIO. The Buffer Mountain and Corral Creek inventoried roadless areas are managed to meet SIOs of High to Very High. The Moderate to Very High SIOs may not be achieved over the long term, as the decline of existing aspen stands may result in considerable deviation from the existing valued landscape character.

Cumulative Effects by Alternative

Alternative A – No Action

Past Actions - The project area has been managed for timber treatment, fuel wood gathering, and a variety of recreational activities. This area has become a regional resource for many recreational activities occurring year-round and a destination for tourists. Some human and naturally caused fires have occurred in the past with a high potential for additional fires in the future. There have been 23 clearcut or partial cut sales in the project area between 1982 and 1992. Between 1999 and 2001, there were seven sanitation-salvage sales. These past harvest activities are listed in the Vegetation section of this chapter. Many of these sales added roads to areas. The old road platforms were not recontoured and evidence of these closed roads would be apparent to casual observers for many years. Other evidence of previous timber harvest activities includes landings, stumps, piles of slash, paint on trees, and old logging roads. There is also evidence of historic logging and mining activities occurring around the beginning of the century. The disturbances caused by human activity in this area have a visual impact on the experiences of visitors. There is evidence of human activity throughout the project area.

Other fuels treatment projects have occurred in the project area, including sanitation and prescribed burns within the Vail ski area. Other management activities which have occurred within the viewing area include road construction, power line and utility corridors (water and gas lines), communication sites, campgrounds, day use facilities, trailheads, bike paths, hiking trails, ski areas, timber treatment, fuel wood gathering, Christmas tree treatment, private residences, and commercial developments.

Concurrent Actions - Management activities, which are taking place at the present time, are a continuation of existing uses, including a variety of year-round recreational activities and fuel wood gathering. One forest health project, the Piney River project, is proposed to begin in 2005. All but 158 acres of this 1,900-acre project area lie outside the project area for the VVFH project. Approximately 1,000 infested or dead trees within the Vail and Beaver Creek ski resorts have been authorized for treatment by the Forest Service under the Vail/Beaver Creek Bug Trees Proposal. Tree removal at the ski resorts usually involves less than 40 trees per acre, or less than 10 percent of the existing trees. The long-term effect of the concurrent actions would be to improve the health of affected lodgepole pine stands, which would enhance the scenic quality of the project area landscape over the long-term. There is also considerable residential and commercial construction occurring throughout the area on adjacent private lands.

Anticipated Actions - There are no additional timber sales in the WRNF Five Year Action Plan for this area. Year-round recreation activities would continue with the potential for increased use. There may be future prescribed burn activity in the area. Additionally, residential and commercial construction is anticipated to continue throughout the area on adjacent private lands.

In addition to vegetation management projects, other anticipated projects on NF administered lands within the project area would affect the scenic integrity of the project area landscape. Two projects currently being considered for the Vail ski resort would add new elements into the landscape. The Vail Wind Farm project would consist of four wind turbines along Ptarmigan Ridge at the Vail ski resort. The Vail Sundown Bowl Lift Upgrades would consist of a chairlift upgrade and a new chairlift installation. Other projects proposed for WRNF lands include a telecommunication site located on Vail Pass near Miller Creek, and the Game Creek vegetation treatment project. The vegetation treatment project involves ongoing noxious weed treatment that would enhance ecosystem health and contribute to the scenic attractiveness of the landscape.

Based on the past, concurrent, and anticipated actions discussed above, the cumulative effects of activities in the project area would not raise the visual impact to a significant level.

Alternative B - Proposed Action

The cumulative effects for Alternative B would not be expected to vary from those described for Alternative A – No Action, except as described below.

The scenic resources of the project area would be positively affected by changes in vegetation that would increase the diversity of species and age classes, and decrease the risk of future MPB outbreaks using the various vegetative prescriptions. The overall visual effect and long-term visual improvement of the vegetation due to the increased species diversity would create a more visually pleasing vegetative mosaic. Lodgepole pine treatments near Minturn for the VVFH Project would remove about 80 to 150 trees per acre, while leaving about 400 to 600 trees per acre, reducing the density of the stands treated by 30 to 50 percent. Areas of high MPB damage and mortality that are currently detracting from the visual quality of the area would be improved by sanitation and salvage treatments. The cumulative effects of past, present, and reasonably foreseeable activities in the project area , including sanitation and salvage in areas where mortality from MPB is high, or possible re-entry after 10 years into the lodgepole pine treatment units to treat ladder fuels or remove enough basal area to effectively modify future MPB risk would not be expected to raise the visual impact to a significant level with the recommended design criteria in place.

Alternative C

The cumulative effects for Alternative C would not be expected to vary from those described for Alternative B, except as described below.

Alternative D

The cumulative effects for Alternative D would not be expected to vary from those described for Alternative B, except as described below.

Forest Plan Consistency

SIOs adopted in accordance with the Forest Plan represent guidelines, which should be met wherever possible. The Forest Plan allows visual disturbances in managed areas, as long as the alterations meet the SIOs. Alternative B would meet all SIOs set by Forest Plan standards and guidelines if the proposed activities do not exceed the scale presented in Chapter 2 and the design criteria are implemented. SIOs of High to Very High in the foreground zones of trails along Gore and Deluge Creeks likely would not be met under Alternative C. SIOs of Moderate to Very High in the Game Creek, Corral Creek, and Buffer Mountain inventoried roadless areas and the Eagles Nest Wilderness may not be met in the long-term under Alternatives C or D. SIOs may not be met over the long-term due to declining aspen stands under Alternative A – No Action. A site specific project-level monitoring and evaluation plan would be developed and implemented as part of any action alternative.

Irreversible And Irretrievable Commitments

Given time, all actions included within these alternatives are reversible. Forested vegetation is a renewable resource and can be managed for many desired attributes. Although changes to the forested landscape are measured in decades to hundreds of years, treatment of the forested vegetation is not an irreversible or irretrievable commitment of resources. Because vegetation grows back over time, timber treatment and prescribed fire activities would not cause irreversible impacts. Until the affected areas recover following treatments, the reduction in visual quality immediately following vegetation and fuels treatments would be an irretrievable loss.

3.4.6 Social and Economic Resources

Resource Description

The effects of the proposed project on social and economic resources were not raised as a key issue during the scoping process. However, project activities have the potential to affect social and economic resources in Eagle County and communities near the project area. The local tourist economy could be affected by perceived improvements or detractions from recreation opportunities. Likewise, the community could be negatively affected by a local wildland fire. Project activities could also have an effect on the Forest Service's relationship with local communities. Local residents rely on the WRNF as a source of both economic and recreation opportunities.

Indicators

- Effects on employment, wages, housing, and community infrastructure
- Relative costs of planned treatments as cost per acre, total cost, and cost per year
- Socioeconomic effects of potential MPB activity (from tree mortality and scenery changes)
- Socioeconomic effects of treatments

Forest Plan Direction

Overall management direction for the WRNF includes the regional goals to provide for a range of recreational opportunities that respond to the needs of forest customers and local communities, and to improve the financial efficiency of all projects (Forest Plan, page 1-1). Forest-wide goals direct that activities improve the capability of national forest and rangelands to sustain desired uses, values, products and services by offering timber for sale, evaluating scenery, providing opportunities for recreation activities, and providing protection and habitat for plant and animal species. (Forest Plan, pages 1-11 and 1-12).

Desired Condition

The desired condition for local economic conditions is to provide local employment and income opportunities by providing access to forest resources. The desired condition for the social environment is a professional and sustainable relationship among local communities, the Forest, and its resources. There is no MA direction specific to social and economic resources within the project area.

Temporal Scope

The short-term impact on social and economic activities in Eagle County and communities within the project area is anticipated to occur for the duration of proposed activities, over a period of up to five years. Long-term impacts to the local tourist economy would occur over an estimated 10-year period, and could occur for the foreseeable future if improved forest conditions help to stimulate the economy by making the forest a more desirable destination for recreationists. Alternatively, if proposed vegetation treatments are not implemented or are not successful, wildland fires could have increased severity or areal extent, causing a negative impact on the local economy for 10 years or more until vegetation has recovered enough to provide scenic landscapes.

Geographic Scope

The project area is located entirely within Eagle County. Eagle County includes those communities most likely to be directly affected by the project activities, and is the focus of the social and economic analysis. These communities include Vail, Minturn, and Avon.

Eagle County is likely to be directly and indirectly economically impacted due to proposed activities that may take place as part of the VVFH project. Effects may occur outside the County, but these effects will generally be so diffused that they cannot be quantified in this analysis.

Affected Environment

This section provides a brief overview of the condition of the social and economic resources within the project area. The Forest Plan Final EIS (pages 3-613 through 698) gives a complete description of the social and economic environment within the boundaries of the project area.

Many residents of these communities depend on tourism and resort-based activities, particularly in the Vail and Beaver Creek ski resorts, which are also located in the project area. Residents of these communities also depend upon other forest resource-related activities and access to resources for their economic livelihood. These forest resource-related activities include collecting wood products, hunting, acting as outfitters and guides, and ranching. Some residents who live around the project area may also consider the forest resources, fire protection, and forest health as an important part of their quality of life.

Visitors, both local and non-local, use the area for a wide range of recreation activities, including alpine skiing, hunting, fishing, camping, hiking, mountain biking, wildlife viewing, snowmobiling, cross country skiing, and snowshoeing.

The social and economic implications of forest resource management are of interest to local residents surrounding the forest, users of forest resources, and to people throughout the United States. Residents of Eagle County will be most likely to experience short- and long-term direct social and economic impacts, both positive and negative, from the VVFH project. Visitors to the Forest may be affected directly in the short-term while in the project area. Future risk of MPB infestation, fire danger, and forest health issues will be of both local and national interest.

Commercial users of the project area may potentially be affected – for wood products operations the impacts are likely to be positive; for permitted outfitters and guides, the impacts may be negative in the short-term.

Demographics

The counties surrounding the WRNF continue to be attractive places for people to live. Since 1990, the population in Eagle County has increased more than 90 percent. Between 2000 and 2010, the county is projected to grow by 12 percent, and by 2020, the county population is projected to grow by 66 percent from 2000 levels **Table 3–76** (CDOLA 2004a). Eagle County's population is projected to increase by more than 3 percent annually in the next two decades. Eagle County's population growth will be significant when compared with a projected growth rate for the United States of 0.8 percent and a rate of 1.7 percent for the State of Colorado. From 1990 to 2000, Eagle County ranked as the 15th fastest growing county in the United States, growing by 82 percent in that 10-year period (Forest Plan Final EIS, page 3-624).

Table 3–76 Population Growth Projected for Eagle County and Colorado

Location	2000	2005	2010	2010	2015	2020
Colorado	4,335,540	4,691,258	5,137,928	5,137,928	5,632,645	6,133,491
Eagle County	43,354	49,601	56,816	56,816	64,436	72,157

Source: CDOLA 2004a

The individual communities likely to be impacted by the project have had significant changes in population between 1990 and 2000 (**Table 3–77**). Avon has increased over 200 percent since 1990. In contrast, Vail has increased only 21 percent and Minturn has increased less than one percent. However, Vail has a large transient population that is not counted in the Census data. Unincorporated Eagle County along the valley bottom between Avon and Vail has also seen considerable population growth. The population in unincorporated Eagle County grew more than 100 percent between 1990 and 2000. Population growth in Avon and unincorporated Eagle County is well above the State of Colorado's average growth rate of 31 percent over the 10-year period.

Table 3–77 Population Trends

Location	1990	1995	2000	2001	2002	Change from 1990 to 2000 (percent)	Average Annual Change from 1990 to 2002 (percent)
Colorado	3,294,473	3,811,074	4,301,261	4,436,725	4,516,845	30.6	3.1
Eagle County	21,928	30,883	41,659	43,497	45,819	90.0	9.1
Avon	1,798	3,533	5,561	5,712	6,081	209.3	19.9
Minturn	1,066	1,036	1,068	1,106	1,120	0.2	0.4
Vail	3,716	4,488	4,531	4,606	4,832	21.9	2.5

Source: CDOLA 2004a

Employment and Income

Employment in Eagle County, including communities in the project area, is dominated by recreation and tourism. **Table 3–78** highlights the number of jobs in 1999 for each industry and the percent of total employment for each sector. In 1999, more than 59 percent of all jobs reported for Eagle County were in the trade and service sectors. These two sectors are generally associated with recreation and tourism activities as well as supporting the growing number of residents and second home owners. Subsectors of the services economic sector include lodging places and amusement and recreation services. These subsectors are indicators of trends in recreation and tourism, although they include dollars spent by residents of the counties as well as by tourists. Also associated with the increase of residents and visitors to the area is the large construction sector employment, with nearly 18 percent of total employment in construction. Those jobs in mining, wood products, and agriculture are significantly smaller, at three percent of total employment. Eagle County accounted for about 21 percent of the jobs in counties of the WRNF in 1999.

Table 3–78 Eagle County Employment by Industry Sector in 1999

Industry Sector	Jobs	Percentage of Total
Agriculture	1,035	2.9
Mining and Extractive Industries	11	0.0
Construction	6,277	17.7
Manufacturing	447	1.3
Transportation, Communications and Utilities	1,161	3.3
Wholesale and Retail Trade	7,889	22.3
Eating and Drinking Places	3,973	11.2
Miscellaneous Retail Trade	1,370	3.9
Finance, Insurance and Real Estate	2,865	8.1
Services	13,086	37.0
Lodging Places	3,484	9.9
Amusement and Recreation Services	4,140	11.7
Government	2,593	7.3
Federal Government, Civilian	169	0.5
State Government	78	0.2
Local Government	2,241	6.3
Total	35,364	100.0

Source: CDOLA 2004b

Table 3–79 displays the income by industry sector in Eagle County and the State of Colorado for 2000. Eagle County made up about 0.5 percent of the state's income in 1990 and 0.6 percent in 2000. The percent of income by sector for Eagle County is different than that of the state. This reflects the large number of tourism-related businesses – ski areas, hotels, restaurants, and retail stores, which are in the services and trade sectors. The larger proportion of construction income in Eagle County is a reflection of the continued growth in recreational facilities, commercial activities, and housing to accommodate growth in the tourist- and recreation-based economy. This trend is also seen in the increase in income from real estate activities.

Table 3–79 Income by Sector in 2000 (thousands of dollars)

Sector	Eagle County		State of Colorado	
	Income	Percentage of total	Income	Percentage of Total
Agriculture	14,685	1.7	1,365,125	1.2
Mining	D[1]	D[1]	1,468,099	1.3
Construction	177,979	20.8	8,984,611	8.2
Manufacturing	15,508	1.8	11,041,914	10.1
TCPU	31,450	3.7	11,392,133	10.4
Trade	153,627	18.0	16,097,210	14.7
FIRE	87,043	10.2	10,499,053	9.6
Services	299,271	35.1	32,864,890	30.0
Government	74,181	8.7	15,808,207	14.4
Total	853,744	100.0	109,521,242	100.0

Source: CDOLA 2004b,
[1]D = not releasable because of disclosure concerns

The lower percentages of income associated with services and trade sectors likely highlight the seasonality and lower wages associated with those positions. While employment figures indicate growth in these sectors, wage and salary figures are not increasing at the same rate, and may be declining in some cases.

The annual unemployment rate declined from 3.5 percent in 1990 to the 2000 unemployment rate of 2.2 percent, a result of the increasing importance of the tourism and recreation industries in a growing state and national economy. Unemployment rates generally peak during May and are at their lowest in the winter months, an indicator of the importance of employment by the local ski industry, as well as other winter recreation. The average annual rate of growth in the total labor force in Eagle County was seven percent between 1990 and 2000. In 2002, the unemployment rate increased and the total labor force growth rate in Eagle County was less than one percent from the 2000 labor force. This was a result of reduced national consumer spending on tourism and recreation in Colorado because of uncertainties about the economy. Wildland fires in other parts of the state also had a role in reduced tourist visits to Colorado, as media coverage of wildland fire incidents was extensive in the national press. **Table 3–80** summarizes labor force trends between 1990 and 2002.

Table 3–80 Labor Force and Total Employment Trends in Eagle County, 1990 - 2002

Sector	Year			
	1990	1995	2000	2002
Total Labor Force	12,525	17,452	21,299	21,455
Employed Persons	12,084	16,884	20,840	20,507
Unemployed Persons	441	568	459	948
Unemployment Rate	3.5%	3.3%	2.2%	4.4%

Source: CDOLA 2004c

Per-capita income is a measure of population and income of an area. In 1990, Eagle County's per-capita income was $22,224 compared with the State's average of $19,680. Between 1990 and 2000, Eagle County's per-capita income has increased 4.7 percent per year, on average. In 2000, the County's per-capita income was $34,997, which was 118 percent of the national average of $29,469, and 107 percent of the State average of $32,434 (Bureau of Economic Analysis 2004).

Forest Resource-Related Industries

The WRNF provides resource opportunities for several resource-related industries; wood products, mining, recreation and tourism, and grazing. Currently, the communities within and surrounding the project area have little infrastructure or employment within the logging or sawmill sectors. All types of recreationists use the project area throughout the year. There are many special use permits for recreation-related services and facilities within the project area, which are described in the Recreation Resources Affected Environment section.

The recreation and tourism industry in Eagle County embraces a variety of businesses that occur within different economic sectors, but are primarily part of the service sector including wholesale and retail trade, transportation, and other services. Subsectors of the services sector include lodging, amusement, and recreation services.

Employment in the amusement and recreation services sector has increased every year since 1990. This increase has occurred even though the State of Colorado has lost market share for tourism since 1993 as a result of funding cuts for tourism in the state (lost revenue of $2.3 million per year since 1993). According to a newsletter prepared by the Colorado Office of State Planning and Budgeting (2002),

Colorado's economy in 2001 and 2002 experienced weaknesses in both travel and tourism. The Colorado Legislative Council indicates that consumer spending and visitation have declined for tourism in the state (Colorado Economic Chronicle 2002). The council concludes that declines in the tourism industry during 2001 and 2002 throughout the State can be attributed to the effects of the recent record-setting wildland fires and drought, as well as consumer concerns about uncertainties in the state and national economies.

Housing

Nearly 26 percent of the current housing stock in Eagle County consists of seasonal housing, which is a decrease of nearly 8 percent from the proportion of seasonal housing to the total housing stock in 1990. Increased numbers of persons have been seeking residence in Eagle County because of opportunities for employment in the various economic sectors that serve the local tourist- and recreation-based economy. Recreation-related real estate development is also a stimulus for growth within the county.

The total estimated number of housing units in Eagle County in 2000 was 22,111. This is a 45 percent increase from the 15,266 housing units in 1990. Housing unit estimates prepared by the Colorado Demography Section summarize the available housing units in the communities in Eagle County as shown in **Table 3–81**. The data show that, despite the growth of the housing stock in the county, the number of units in Vail decreased by 12 percent during the 1990s. This is probably because residential building trends in Vail are dominated by the construction of high-end single-family homes, and older condominium units have been removed to create room for single-family homes. In contrast, most construction of housing units in the county, including condominium units and single-family housing units, has occurred in the valley between Avon and Vail, outside municipal limits, and house residents and visitors to the valley. There has been little space for the development of additional housing in Minturn.

Table 3–81 Housing Units in Eagle County

Municipality	1990		2000		Percentage Change 1990 - 2000	
	All Housing Units	Seasonal Use Units	All Housing Units	Seasonal Use Units	All Housing Units	Seasonal Use Units
Eagle County	15,226	5,138	22,111	5,932	45	15
Minturn	434	9	448	32	3	256
Vail	6102	3586	5389	2888	-12	-19

Source: CDOLA 2004d

The vacancy rate for 2000 (the most recent year available) was 2.4 percent. The median housing price in 2000 was $350,000, which is considerably higher than the statewide median housing price of $166,600 in 2000.

It is expected that the demand for new housing in the county will continue to rise as improvements in the state and local economy stimulate additional growth in tourist and recreational visits to the county. The available housing data suggest that building activity is not keeping pace with current population and employment growth. The units currently being built do not meet the housing demands at the low end of the price spectrum.

Community Infrastructure

Fire protection in the project area is provided by the WRNF, Eagle River Fire Protection District, and Vail Fire and Emergency Services.

The WRNF shares wildland fire suppression resources with other federal government agencies nationwide. Interagency wildland fire crews are dispatched where they are needed. Contractors are also used for wildland fire suppression activities.

The Eagle River Fire Protection District includes the portion of the project area along the Eagle River, the Eagle-Vail area, and the towns of Avon and Minturn. The district in the project area covers rural areas, National Forest, wildland urban interface, residential areas, high-rise resort facilities, and a portion of the I-70 corridor. The services provided by the fire district include fire suppression, medical emergencies, rescue/extrication, hazardous materials response, and service calls (Eagle River Fire Protection District 2004).

The Town of Vail is served by the Vail Fire and Emergency Services, which cover a 40 square mile service area. The department operates two fire stations with seven fire apparatus. Services provided by the department include basic emergency medical services (EMS) and fire and rescue services (Vail Fire and Emergency Services 2004).

The Vail Valley Medical Center provides health care for 50,000 residents in six counties. Facilities include 49 beds and a level III trauma center. Clinics affiliated with the medical center include the Beaver Creek Medical Center, which provides emergency health care (Vail Valley Medical Center 2004).

Environmental Effects

Direct and Indirect Effects by Alternative

The environmental effects section analyzes the effects of the proposed treatments on the economy and social structure of the project area and Eagle County for each alternative. The analysis assumes that proposed vegetation treatments would successfully manage future MPB risk and wildland fuel hazard and would help lower the likelihood of the occurrence of a large scale crown fire in the treatment areas if the project is implemented. The number of acres proposed for treatment under each action alternative is small relative to the entire project area; however, because most treatment units are located in the wildland urban interface, the benefits of treatment would extend beyond the treatment units to nearby developed areas of Vail Valley.

Alternative A – No Action

The implementation of the No Action alternative could have consequences on the economies of Vail Valley and Eagle County. Some of the economic consequences could reach beyond the local economy and affect state and federal budgets as well. The analysis draws extensively on the Hayman Fire Case Study Analysis (Graham 2003), which contains the interim findings of the socioeconomic team. According to the report, the social and economic consequences of wildland fires have not received the attention that ecological issues have.

There is a broad range of possible outcomes on the social and economic resources of Vail Valley and Eagle County from the implementation of the No Action alternative. The analysis will focus on the potential effects of large-scale crown fire and MPB activity, as these scenarios have a high probability of occurrence in the project area. The assumption of wildland fire hazard is based on published sources and the existing condition of the forest in the project area, which includes increasing stand density as well as MPB infested lodgepole pine.

The costs associated with the Hayman Fire, which burned 138,000 acres in four Colorado counties in 2002, are used to identify potential costs that would be associated with a large scale crown fire in the Vail Valley project area. The costs presented for Vail Valley are not intended to provide an accurate estimate of costs that would result from a large-scale crown fire, as these costs are difficult to predict for complex

social and economic systems (Graham 2003). The following estimates are intended only to show the magnitude of the costs of a large-scale crown fire in the Vail Valley.

The cost of the Hayman Fire has approached $240 million, which includes $42.2 million in suppression costs, $38 million in insured property losses, $34 million in timber destruction, $23.7 million in rehabilitation costs to date, and nearly $1.0 million associated with recreation. The insured property losses include 132 homes that were destroyed by the fire.

The Colorado State Forest Service has conducted the Colorado WUI (Wildland/Urban Interface) Assessment Mapping Project (Reference), which identifies high fire hazard risk areas. The assessment uses risk, hazard, and value map layers to determine fire danger in wildland urban interface areas. One of the final map outputs was a Red Zone map, which displays high hazard areas in red. The entire Vail Valley project area is contained within the high hazard area displayed on the map.

Demographics

A wildland fire at the wildland urban interface would likely decrease the population of Vail Valley and Eagle County because of property and resource loss. The long-term effect of wildland fire damage to personal property and forest resources would be partial loss of the tourist- and recreation-based economy. This impact would continue until burned areas have recovered, damages to local property and business have been recovered, and the economy has returned to pre-fire conditions. The permanent population of the region would decline during this period of recovery, as many people are employed in service industries that would suffer negative economic impacts from a large wildland fire.

The effects to the population from unmanaged MPB would be similar. The current epidemic levels of MPB in the Vail Valley could kill up to 50 to 70 percent of lodgepole pine, which would be detrimental to scenic quality and recreational opportunities, which is an attraction for the permanent population as well as for visitors to the valley. The Vail Valley and Eagle County economies are based on tourist and recreation services, which depend on the scenic resource as a setting for alpine skiing as well as numerous other recreation activities.

Employment and Income

The Colorado Economic Chronicle estimated that the effects of wildland fire and drought decreased visitation in 2001 at tourist attractions in Fremont County by 12 to 15 percent. These declines occurred after wildland fires in the area started in June 2001. None of the attractions was damaged by wildland fire, so the decreases in visitors were attributed to the attention the fires received in the national press. These declines affected tourist activity reported at state levels, although tourist visits to the state returned to pre-fire levels the following year. A similar decline in tourist visitation to the Vail Valley could occur from the occurrence of wildland fires in the region, even if the fires did not damage homes or businesses located in wildland urban interface areas. This type of loss would likely occur only during the season of reported wildland fires, as tourist visits would probably recover the following year. These declines would result in a short-term loss of jobs in local service businesses.

A large-scale crown fire that would involve major fire damage to properties would have greater effects on the local economy, and would be felt through all businesses in the local economy for a longer period of time. Such a wildland fire would cause substantially greater declines in tourist visitation than the 12 to 15 percent experienced in Fremont County in 2001. The direct impacts to the local economy would occur until the scenic landscape has been re-established and property damages have been recovered. Indirect effects include the economic recovery of the area that would take place over an undetermined period of time after the re-establishment and recovery of resources and properties.

Many second homes are located in wildland urban interface areas because of the scenic setting provided by such areas. The loss of these structures and the loss of the scenic landscape would result in substantial declines in the large seasonal population of Vail Valley, which includes second homeowners as well as seasonal employees. Both groups contribute to the local economy by spending dollars at local businesses.

A study prepared by the Colorado State University Forest Sciences program has estimated that the economic impact of wildland fire on wildland fire urban interface areas can cost up to $4,800 per acre. This cost includes rehabilitation, subsequent flooding, loss of property values, and lower property taxes. The maximum estimate of $4,800 per acre is a reasonable cost to use for the Vail Valley area because the valley contains residential uses in wildland urban interface areas with high property values, and because the loss of ski areas and other recreation facilities on public and private lands would carry a high dollar cost for reconstruction and rehabilitation.

A large-scale crown fire scenario is used in the following analysis only to illustrate the magnitude of potential economic losses in the Vail Valley project area. This scenario is only one of many possible scenarios, and is not intended to be an estimate of how many acres would burn in the event of a large scale crown fire, or to provide an accurate dollar figure for any potential economic losses. An estimated 24,000 acres, or nearly one-third of the project area, could burn in a large scale crown fire. This estimate was derived by identifying large, contiguous areas of lodgepole pine and spruce/fir vegetation types in the project area, and calculating the number of acres within these contiguous areas. These vegetation types would have the greatest potential for destructive wildland fire. Under this scenario, the costs of forest and property rehabilitation, loss of property values, and lower property taxes would be more than $115 million, based on the estimated cost of $4,800 per acre. Included in the $115 million are costs that would accrue to various entities, including the Forest Service, Eagle County, businesses, and individuals who are affected by the fire.

Fire suppression costs, also included in the $115 million, were estimated for the Hayman fire at $1,497 per acre. Fire suppression costs for a wildland fire in the project area would be comparable. The large scale crown fire scenario discussed above would burn 24,000 acres, at a total estimated cost of $36 million.

Potential losses of revenues from visitors to the Vail Valley would also be substantial. A minimum 12 to 15 percent drop in tourist visits would result in a substantial impact to an economy based on tourism and recreation from lost sales tax and business revenues. It is likely that the revenue loss would substantially exceed the nearly $1.0 million loss experienced by local economies affected by the Hayman fire. Other costs to businesses and individuals would include doctor and medical expenses, lost productivity, and increased water treatment costs.

The impact to the local economy from MPB would be less than the impact of a large scale crown fire; however, the current epidemic levels of MPB in the Vail Valley could kill up to 50 to 70 percent of lodgepole pine, which would be detrimental to scenic quality and recreational opportunities. The Vail Valley and Eagle County economies are based on tourist and recreation services, which depend on the scenic resource as a setting for alpine skiing as well as numerous other recreation activities.

There would be costs incurred by the Forest Service, utilities, and homeowners in forested areas from the continued MPB infestation of the forest. Increased costs to the Forest Service would include trail maintenance due to additional deadfall; recreation area management costs due to high-value individual tree protection, hazard-tree reduction, fire protection, and reduction in use fees; and road maintenance costs due to deadfall and hazard tree removal. Trees falling on utility lines would increase utility maintenance costs. Homeowners would experience costs from the loss of value through the death of landscape trees, degraded views, and dead trees falling on improvements (USFS 2000b)..

Housing

Many existing homes have been built in close proximity to NFS lands in the project area. The rapid growth of 45 percent between 1990 and 2000 in the housing stock of Eagle County has occurred mostly in rural areas outside of incorporated municipal limits. The overall area of land developed with residential or commercial uses in rural areas, which includes forested areas on NFS and private lands, has increased the number of structures that are in the wildland urban interface. The result is a direct correlation in the increased potential for wildland fire damage to structures from development in interface areas. It is likely that the demand for new housing resulting from the increased population projected for Eagle County will stimulate the further development of housing in interface areas.

The Hayman fire resulted in the destruction of 132 out of 794 houses (16 percent) located within the fire perimeter. The value of losses was estimated for those properties located in Teller County. One hundred and fourteen privately owned properties had resources lost or homes destroyed in Teller County; their value was estimated at $5.5 million before the fire. The fire resulted in losses estimated at $3.3 million, which is an approximate 60 percent loss in the value of these properties. There were 208 Teller County homes in the fire perimeter. Eighty-two, or 39 percent, of these homes were destroyed in the fire.

The Jefferson County assessor's office has reduced property values for properties damaged in the Hayman fire. Values for burned acreages are reduced by 50 percent, and burned structures are reduced up to 100 percent. In addition to the loss of the property value, the tax revenues from these properties to the county are lost.

The total estimated number of housing units in Eagle County in 2000 was 22,111. The majority of houses in Eagle County are located in urban and rural areas along the I-70 corridor, which traverses the Vail Valley. The project area and the potential burn perimeter area includes most of census tracts 5 and 7, and the town of Minturn, which is not within these census tracts. The total number of housing units within the census tracts and Minturn is 11,975, which is more than half of the homes in Eagle County. Using the percentage of housing lost in the Hayman Fire, about 1,900 houses may be destroyed by a large scale crown fire in the Vail Valley.

It is likely that the estimate of 16 percent destruction of houses is high because many homes in Vail, Minturn, and Avon are easily accessible from I-70 for fire fighters and would be successfully protected in the event of a wildland fire. The homes most at risk in the wildland urban interface are outside of municipal limits and lack easy access. According to the 2000 Census, 4,240 housing units are in rural areas of the census tracts and Minturn. These houses have a higher risk of damage or destruction by a large scale crown fire.

The average price of housing in the Vail Valley was $350,000 in 2000. In the event that 1,900 housing units are destroyed in a wildland fire, there would be an estimated $665 million lost in property damage or destruction. As in other sections of this analysis, these numbers are intended to show the potential magnitude of losses, and do not represent a prediction of actual losses. At a 2002 residential assessment rate of 9.15 percent, and a county mill levy, of 6.999, Eagle County would lose over $4 million in property taxes. These tax losses to the county would continue until the properties have been rehabilitated.

The loss of population and the negative impact on the local economy from continued MPB activity would result in a small number of homes sold annually and constructed in the Vail Valley. While this would slow the ongoing encroachment of development into the open spaces of the valley, there would be a loss of jobs in the construction industry, which generates more than a 20 percent share of the total income in the county. The detrimental effect to the scenic landscapes, as well as a slowing economy, would decrease the quality of life, which would result in a further devaluation of property and a loss of property taxes to the county government.

Community Infrastructure

It is likely that all of the existing fire protection resources in the project area would be involved in the suppression of any large scale crown fire. Interagency wildland fire crews would be dispatched from other areas as needed.

The Vail Valley Medical Center and affiliated clinics provide emergency care for residents in the project area. In the event that a wildland fire results in numerous injuries, the clinics may find it difficult to provide emergency health care. There could be injuries and potential loss of life for fire fighters, residents, and visitors. Health problems could appear or be exacerbated by smoke inhalation.

Economic Efficiency

There would be no costs incurred by the Forest Service for treatment activities under the No Action alternative. However, there could be significantly large costs to the Forest Service; federal, state, and local governments; businesses; and individuals from a large scale crown fire. These costs would likely be significantly higher than the costs associated with treatment activities.

There would also be costs associated with the loss of revenue from tourist activities if the anticipated decline in the scenic quality of the Vail Valley from MPB-related lodgepole mortality resulted in a decrease in tourist visits to the area. These costs would affect the Forest Service as well as businesses and local governments. In addition, there would be increased management costs to the Forest Service for all resources affected by MPB-related tree mortality.

Alternative B

The effects of wildland fire under Alternative B would be similar to Alternative A, but reduced fuel loads and enhanced fuelbreaks under Alternative B may lessen the severity or extent of the burn, potentially reducing the social and economic effects of wildland fires under Alternative B. Indirect effects from the project would include a reduction in the intensity of wildland fires near residential areas. Wildland fires are likely to occur in the project area, but the acres burned and the intensity of the burn could be reduced under Alternative B, thus potentially reducing effects on residential areas.

Alternative B would contribute to the continued health of the economy and overall well-being of the social structure of the project area and Eagle County. The benefits to the local tourist- and recreation-based economy would range across all sectors of the local economy.

Demographics

Population effects from the project workforce would not be noticeable. The skills and services required for the project would be provided by current Forest Service personnel and by local contractors.

Current and projected trends in the demographic characteristics of the population in the project area are described for the affected environment, and are expected to continue with the successful implementation of the proposed project. The long-term improvement of the declining condition of MPB infested areas and reduced wildland fire hazards would contribute to the attractiveness of the region as a tourist destination. This would benefit the continued growth of the local economy and the permanent population.

There is some potential for the local population and visitors to Vail Valley to experience short-term negative visual impact from smoke during broadcast burning and pile burning. However, the prescribed burn treatment units are located away from residential areas, and burning would be timed to minimize the

visual impacts of smoke. Therefore, health effects are not expected. Trails and roads that access prescribed burn treatment units would be closed temporarily, as needed, during the treatments.

Employment and Income

Minimal merchantable timber would be produced from lodgepole treatment units, as the primary goal for treatment is reduction of fuels and future MPB risk. The action alternatives would create very modest opportunities for logging/merchant service contracts that may be operated by local wood products companies. There is likely to be little direct impact within Eagle County from the commercial timber harvesting due to a lack of wood products industry and infrastructure. However, some employment activity would be supported through the stewardship activities as well as the thinning, harvesting, and planting.

Employment and income from tourism activity is significant in Eagle County. A majority of this activity is based on private commercial developments such as resort-based facilities associated with Forest Service permitted ski areas. A small portion is directly related to recreation opportunities on NFS land within the project area.

The displacement of any recreational activity and any resulting economic effect would be short-term, as discussed in the recreation section. Also, for any displaced activity, there would be several substitute sites and opportunities on nearby NFS lands. Alternative B provides for mitigation measures to decrease any potential impacts to other resource users. In addition, treatment activities would occur within 5 years, so that only a small percentage of the project area would be undergoing treatment at any one time. It is not likely that the overall number of persons engaging in these activities would change because of treatment; therefore, there would be no measurable economic effect from the displacement of recreation activities.

Alternative B would not change the current situation for grazing. There also would be no changes to access or use of mineral resources.

Housing

It is anticipated that the workforce that would implement the treatments prescribed for the units under Alternative B would be supplied by current Forest Service personnel and local contractors. In the event that additional workforce from outside of the region is required for project activities, there would be a relatively small demand for temporary housing that could be accommodated by existing resources. Communities in the Vail Valley area provide a wide range of temporary housing and seasonal housing. Demand for temporary and seasonal housing by the project workforce would occur during spring to fall months, when high vacancy rates would ensure a plentiful supply.

Community Infrastructure

Successful implementation of the project would reduce hazardours fuels and future MPB risk in the wildland urban interface. The existing fire protection resources should continue to be adequate.

Economic Efficiency

Costs for Alternative B include planning costs, which are the same for all action alternatives and include all internal work required for land management activities. Other costs for aspen treatments, lodgepole treatment, piling and prescribed burning, and maintenance for trails, road maintenance, decommissioning, and management would be similar for the action alternatives.

The financial benefits of Alternative B would accrue to all sectors of the local economy, and would be long-term and difficult to value in terms of dollars. Benefits such as forest health, scenery, noxious weed control, riparian protection, watershed improvements, and fuel reductions are non-market benefits that cannot be quantified, but provide the setting for the local tourist- and recreation-based economy.

The costs of implementing the proposed treatments would be considerably lower than projected costs associated with suppressing a wildland fire in the wildland urban interface in the Vail Valley and the socioeconomic effects of that fire on the area. While implementation of Alternative B would provide no guarantee that a wildland fire would not occur, and implementation of the No Action alternative would not make it certain that a large wildland fire would occur, a wildland fire occurring under Alternative B may have reduced severity or areal extent than under the No Action alternative. Given the considerable socioeconomic cost of a large wildland fire to the Vail Valley and Eagle County, any action that could lessen severity or extent of a wildland fire would represent a substantial beneficial socioeconomic impact.

Each alternative's cost results from differences in the number of acres that would be treated and the treatment methods. Alternative B would likely be the most cost-effective of the action alternatives per acre to implement. Alternative B would treat the most acres of any action alternative and would involve the most broadcast burning. Broadcast burning is a cost-effective treatment method that is also long-lasting when compared with mechanical treatment methods. Also, while lodgepole pine treatment units would not vary among the action alternatives, under Alternative B the most cost-effective access to units 101 and 102 would be used.

Environmental Justice

No potentially adverse effects that disproportionately affect Native American tribes or minority or low-income groups have been identified. The project area does not contain tribal lands or Indian communities, and no treaty rights or Indian trust resources are known to exist for this area. No communities within the project area would be likely to be physically affected by the reasonably foreseeable development of vegetation treatment for MPB and fuels reduction. The effects from Alternative B would not be disproportionate to those experienced by the general population. The proposed environmental and socioeconomic effects are spread across all races, ages, and income levels.

Alternative C

The social and economic effects of implementing Alternative C would be the same as for Alternative B with the exception of economic efficiency. The cost differences for Alternative C result from the number of acres that would be treated and the treatment methods. Alternative C would likely be the least cost-effective of the action alternatives per acre to implement because it involves less cost-effective treatments. Alternative C would treat fewer acres than Alternative B and would not involve broadcast burning. Only mechanical treatments and pile burning would be used for fuels treatments. Lodgepole pine treatments in Units 101 and 102 would involve the use of a cable system and would require an adverse haul along tractor trails, which would increase costs for these treatments.

Alternative D

The social and economic effects of implementing Alternative D would be the same as for Alternative B with the exception of economic efficiency. Alternative D would likely be the least expensive of the action alternatives to implement because it is similar to but treats fewer acres than Alternative B. Treatments would not occur more than 200 feet inside the boundary of any inventoried roadless area, which would limit the cost of Alternative D.

Cumulative Effects by Alternative

Alternative A – No Action

Only actions by state and local governments and individuals would contribute to the reduction of hazardous fuels or future MPB risk in the Vail Valley or Eagle County under the No Action alternative. Considering the large percentage of NF administered lands within the project area where no action would be taken to reduce fuels or future MPB risk, the positive social and economic effect of these vegetation management actions would be reduced over the short term and long term in the project area.

Alternative B

When the VVFH project is combined and considered cumulatively with other reasonably foreseeable actions in the Vail Valley and Eagle County, it appears likely that those actions contributing to the reduction of hazardous fuels or future MPB risk would have a positive social and economic effect in the long-term. It is also likely that some social conflict and lifestyle changes may occur in the long-term as agencies and communities address relative priorities for future activities, including vegetation treatments, commercial development, residential developments, road improvements, road closures, and additional recreation/tourism facilities. Fire protection resources would likely need to be increased in response to the increased interface area that will result from ongoing residential and commercial development in the Vail Valley. These resource management activities may occur on the NF administered lands or private and state lands sin the project area.

Alternative C

The cumulative effects for Alternative C would not be expected to vary from those described above for Alternative B.

Alternative D

The cumulative effects for Alternative D would not be expected to vary from those described above for Alternative B.

Forest Plan Consistency

All alternatives meet Forest Plan direction for providing the opportunity for economic growth of communities and recreational opportunities through access and management of National Forest resources.

Irreversible and Irretrievable Commitments

An irreversible or irretrievable commitment of resources would occur if resources are consumed, committed, or lost as a result of the project. The commitment of resources would be irreversible if the project started a process (chemical, biological, or physical) that could not be stopped. There are no social or economic effects from the action alternatives that would be irreversible.

Commitment of a resource would be considered irretrievable when the project would directly eliminate the resource, its productivity, or its utility for the life of the project and possibly beyond. Any of the action alternatives would temporarily eliminate the use of some trails in the project area or cause a negative visual impact from treatment activities, potentially resulting in the loss of revenues to the local economy if the tourist dollars are spent elsewhere. However, the likelihood of such a result would be small, as the project area contains sufficient recreation opportunities to offset the temporary loss of an opportunity. Therefore, no irretrievable commitment of social or economic resources would occur.

3.5 SPECIFICALLY REQUIRED DISCLOSURES

This section contains disclosures of effects that are specifically required by federal law, regulation, or policy.

3.5.1 WETLANDS AND FLOODPLAINS

Wetlands in the project area will not be impacted by the project. The design criteria, discussed in **Appendix D**, describe that wetlands will be delineated prior to implementation and vegetation treatments and all treatment units will be located at least 100 feet from wetland areas.

This subject is documented in Chapter 3, Streams and Watershed section. Riparian ecosystems within the project area are protected and managed in accordance with Forest Plan standards and guidelines and Watershed Conservation Practices.

3.5.2 NATIONAL FOREST MANAGEMENT ACT COMPLIANCE

All proposed vegetation treatments are consistent with the National Forest Management Act of 1976 as documented in the *Project File*. This consistency assures that timber will be harvested from National Forest lands where soil, slope, or other watershed conditions will not be irreversibly damaged. There is assurance that such lands can be adequately restocked within 5 years after harvest. There is also assurance that the clearcutting method, where implemented, is the optimum treatment method, and that other treatment methods are appropriate in other areas. This consistency also includes that the stands of trees proposed for treatment have generally reached the culmination of mean annual increment of growth.

3.5.3 THREATENED AND ENDANGERED SPECIES

The direct, indirect, and cumulative effects upon threatened and endangered species are discussed in Chapter 3 in the Wildlife and Aquatic Life sections. They are further documented in the Biological Assessment located in the *Project File*.

3.5.4 PRIME FARMLAND, RANGELAND, AND FOREST LAND

All alternatives were designed in accordance with the Secretary of Agriculture Memorandum 1827 for prime farmland, rangeland, and forestland. Regardless of the alternative, National Forest System lands will be managed with sensitivity to any adjacent private and public lands. There are two grazing allotments for sheep within the project area. Prescribed burns associated with the project would be likely to occur in the spring before sheep are turned on to the affected allotments, or in the fall, after sheep have left.

3.5.5 EFFECTS ON THE HUMAN ENVIRONMENT

The supplies of commodities may affect local consumers. This topic is documented in Chapter 3 in the Social and Economic Resources section.

The civil rights of any American citizen, including women and minorities, are not differentially affected by implementation of any alternative.

3.5.6 ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL

Alternative A, the No Action alternative, has the least impact on fossil fuel consumption. However, the energy required to implement any of the alternatives, in terms of petroleum products, is insignificant when viewed in light of production costs and the effect on the national and worldwide petroleum reserves.

3.5.7 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

Adverse effects on some components of the environment cannot be avoided. Actions to benefit one component may have at least temporary adverse effects on another. A broad range of alternatives has been formulated, and the alternatives include management requirements and design criteria and mitigation measures to avoid or reduce adverse environmental effects.

3.5.8 SHORT-TERM USES OF THE HUMAN ENVIRONMENT AND THE MAINTENANCE OF LONG-TERM PRODUCTIVITY

Short-term uses are those that generally occur on a yearly basis, such as livestock grazing as a use of the forage resource or timber harvest as a use of the wood resource. Long-term productivity refers to the capability of the land to provide market and amenity outputs and values for a 50-year period or longer. The quality of life for future generations is linked to the capability of the land to maintain its productivity. For this proposal, management requirements and design criteria/mitigation measures built into the action alternatives ensure that long-term productivity will not be impaired by the application of short-term management practices.

3.5.9 CONFLICTS WITH OTHER AGENCY GOALS AND OBJECTIVES

Public involvement with other federal and state agencies indicates that there are no major conflicts between the provisions of the proposed action and the goals and objectives developed for other governmental entities.